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VICTORIA.

DEPARTMENT OF MINES.

RECORDS

OF THE

GEOLOGICAL SURVEY OF VICTORIA.

Vol. I., Part 1.

(Edited by Professor J. W. GREGORY, F.R.S., D.Sc., Director.)

ISSUED BY

W. R. ANDERSON, SECRETARY FOR MINES, UNDER THE AUTHORITY
OF THE HON. EWEN H. CAMERON, M.P., MINISTER OF MINES.

By Authority:
ROBT. S. BRAIN, GOVERNMENT PRINTER, MELBOURNE.
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PREFACE.

The Board appointed in March, 1901, by the Hon. the Minister of Mines, to draw up a scheme for the re-organization of the Geological Branch of the Mines Department, suggested among its other recommendations that efforts should be made to issue its publications in a more systematic form than had previously been adopted. The Board recommended that the publications should be issued as serial Records, including papers of general geological interest; as Special Reports dealing with subjects which require immediate attention, and less frequent subsequent reference; and as Monographs containing detailed researches on various branches of Victorian geology.

In accordance with this recommendation the Hon. the Minister of Mines has decided on the publication of the "Records of the Geological Survey of Victoria," which begin with this part. Having been temporarily appointed Director of the Geological Survey, it has fallen to my lot to edit this number. Most of the material had been collected by Mr. H. Herman, B.C.E., F.G.S., during his service as Acting Government Geologist during 1900 and 1901. I am much indebted to Mr. Herman for his assistance in passing the number through the press.

The terms Eocene, Miocene, and Pliocene are accepted in accordance with their conventional use in Victoria; and their provisional retention by the Survey does not imply agreement with the correlation adopted by the authors of the various reports.

J. W. GREGORY.

29th May, 1902.

1.—DESCRIPTIONS OF NEW OR LITTLE-KNOWN VICTORIAN PALÆOZOIC AND MESOZOIC FOSSILS.—No. III.*

(*By R. Etheridge, Junr., Curator of the Australian Museum, Sydney.*)

1.—INTRODUCTION.

The following Notes refer to the better-preserved specimens in a collection of very fragmentary plant remains from the following localities :—Parish of Kongwak ; Outtrim railway bridge ; Welshpool ; Skene's Creek ; Irvine's Creek ; and Jumbunna East.

With the exception of a few known forms, I have not attempted to attach specific names to the specimens, but have simply indicated the possible generic relationship of the few that exhibit characters of a determinable nature. The indiscriminate showering down of specific names on the strength of indefinite material is the cause of endless trouble to the palæontologist, and should always be avoided unless there appears to be a reasonable chance of future recognition at the hands of subsequent workers. The annals of Australian palæontology exhibit some glaring instances of this practice.

The plants are wholly of Mesozoic age, and may be referred to under the comprehensive term employed by Dr. R. L. Jack in relation to similar deposits in Queensland, that of Trias-Jura.† They are so far of interest that some of the specimens seem to foreshadow the occurrence of at least two genera not hitherto known to occur in Australia.

2.—DESCRIPTIVE NOTES.

Equisetaceous stem.

(No. 263.)

Obs.—Although only a fragment, this specimen is of interest, for, so far as published references enable one to judge, equisetaceous stem fragments do not appear to be common in Victorian Mesozoic beds.

The stem fragment is 4¼ inches long by ¾ of an inch wide, and exhibits one entire node and two half nodes ; the former is 1¾ inches long, and beyond a coarse fluting and ridging no other structure is visible.

It may be either *Phyllotheca* or *Schizoneura*, but as neither foliage nor sheaths are preserved it is impossible to determine the fragment accurately. *Phyllotheca* is recorded by Selwyn,‡ from the Cape Patterson Coal-field (*Phyllotheca australis*, according to Smyth,§ as determined by McCoy) ;

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* For Nos. I. and II. see Progress Report of the Geological Survey of Victoria, No. XI., p. 30, and Monthly Progress Report of Geological Survey of Victoria, No. XI., p. 22.

† In a later communication, dated 26/6/01, Mr. Etheridge says—"I am of opinion that it is in accordance with our present knowledge to speak of the Cape Otway and South Gippsland beds as Trias-Jura, rather than as Jurassic simply. I believe the Mesozoic plant beds of the entire continent to form only portions of one great period homotaxial with strata developed in other parts of the world at the close of the Triassic and beginning of the Jurassic periods. The exact relations of the beds forming the various isolated areas in Australia to one another has, however, still to be worked out."

‡ Selwyn, Phys. Geogr. Geol. and Min. Vict., 1866, p. 20.

§ Smyth, Geol. Survey Vict., Report of Progress, 1874, I., pp. 24 and 35.

from the Western Port Coal-field, by McCoy[*] in person ; both from Cape Patterson and Bellarine by the same observer[†] ; and lastly, from the Albert River by Mr. James Stirling,[‡] who places the plant in the Coniferæ, and makes some curious remarks on it.

Loc.—Kilcunda district.

Baiera subgracilis, McCoy.

(Nos. 277, 293, 377, 380, 437, 450, 453, 457, 458, 460, 462, 464, 470.)

Obs.—In 1892 Mr. James Stirling published[§] this MS. name of McCoy, with a figure only of a specimen from Korumburra, Gippsland, and again additional figures in 1900,[‖] with the following remarks :—"This elegant species has in many respects a striking resemblance to the *Ginko Simmondsi* of Shirley, which occurs along with a *Tæniopteris* in the Ipswich beds of Queensland, except that the linear segments are broader, and the nerves more pronounced in the Victorian species."

Valid grounds for the separation of the Victorian and Queensland plants do not appear to me to exist—the breadth of the linear leaf-segments is merely a question of growth, and the pronunciation of the nerves one of preservation. As Mr. Shirley's name[¶] was accompanied by both detailed description and figure, it must take precedence of Professor McCoy's. Further, however, I am of opinion that *Baiera subgracilis*, McCoy, and *Ginkgo Simmondsi*, Shirley, are both synonymous with *Jeanpaulia palmata*, Ratte,[**] anterior in date of publication to either. To render this clear, I may further add that I regard Shirley's species not as a *Ginkgo*, but a *Baiera*, and that *Jeanpaulia*, the generic name made use of by the late Mr. Ratte, is simply a synonym of *Baiera*.[††] A further complication arises from the fact that the specific name given by Ratte was preoccupied, as explained by Dr. O. Feistmantel,[‡‡] who proposed in the place of the latter that of *Baiera flabelliformis*, and this is the name I believe the Victorian plant should bear.

Associated with the foregoing plant amongst the specimens from the parish of Kongwak and Outtrim bridge, a few other specimens (No. 279, &c.) are proportionately so much more delicate that I felt inclined to refer them to *Baiera bidens*, Ten. Woods,[§§] but further consideration has led me to regard them as younger individuals of the same species—*B. flabelliformis*.

Throughout the collection from the parish of Kongwak occur numerous ovate, elliptical, or very slightly pyriform and more or less flattened bodies (Nos. 348, 408, 418, 422, 435, 440, 446, 455, 468), which, I think, are without doubt the seeds of *Baiera*. Each seed has a small flattened flange-like border, but only in one instance is the peduncle preserved. These bodies vary in size from 6 to 11 millimetres in length, and bear a very close resemblance to the seeds of *B. münsteriana*, Schenk, sp.[‖‖] It is quite legitimate to suppose that these are the seeds of *B. subgracilis*, McCoy.

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[*] McCoy, Report of the Western Port Coal Commission, 1871–72, p. 6.

[†] McCoy, Ann. Mag. Nat. Hist., 1867, XX., p. 196.

[‡] Stirling, Dept. Mines Vict., Reports on Victorian Coal-fields, 1900, No. 7, p. 5.

[§] Ibid. 1892, p. 12, t. 2, f. 13.

[‖] Ibid. 1900, No. 7, p. 5, t. 1, f. 4–7a.

[¶] Shirley, Bull. Geol. Survey Queensland, 1898, No. 7, p. 12, t. 2.

[**] Ratte, Proc. Linn. Soc. N.S. Wales, 1887, I (2), pt. 4, p. 1078, t. 17.

[††] Saporta, Pal. Franç. Vég. Terr. Jurassique, iii., p. 270.

[‡‡] Feistmantel, Geol. Survey New South Wales, Pal. Mem., No. 3, 1890, p. 158.

[§§] Tenison Woods, Proc. Linn. Soc. New South Wales, 1883, viii., pt. 1, p. 132, t. 4, f. 3.

[‖‖] Saporta, Pal. Franç. Vég. Terr. Jurassique, iii., t. 28, f. 5–6d.

Trichopitys ? sp.

(No. 463.)

Obs.—Amongst the many problematical plant remains is an interesting fragment that recalls to mind the long, delicate, coriaceous, and bifurcate leaves of the taxaceous conifer *Trichopitys*, not unlike *T. lindleyana*, Schimper,* but possessing a stouter habit.

The base of attachment has gone, but there are two branches of leaves, each bifurcating and rebifurcating, and no trace of the single median nerve to each leaf, possibly destroyed in the bituminization the specimen has undergone.

The determination cannot be considered conclusive, but the resemblance is very strong.

Schizolepis ? sp.

(Nos. 441, 448.)

Obs.—Other fragments recall the long, acicular, straight leaves of the the above, another taxaceous conifer, particularly the uninervate leaves ascribed by Mr. A. G. Nathorst to his *S. Follini*,† from the Scandinavian Rhætic. These leaves are too long and parallel-sided to be ascribed to either *Palissya* or *Cunninghamites*, and their uninervate condition removes them from *Voltzia*. In one specimen five leaves are arranged as if radiating from a common stem, but this central point is hidden in matrix that cannot be removed.

Loc.—Jumbunna East.

Cordianthus-like infloresence.

(No. 267.)

Obs.—A very peculiar and dubious fragment may possibly belong to that series of infloresences known as *Cordianthus*. It is sufficiently interesting to cause one to wish for more and better material.

The specimen, which is but a carbonized impression, consists of an axis giving off short lateral stalks, sub-opposite, and terminated by what look like compressed, elongately cordiform buds, some of them apparently protected by bracts.

Loc.—Parish of Kongwak.

Phyllopteris ? sp.

(Nos. 269, 276, 343, 346, 349, 373, 396, 397, 400–402, 412, 425, 459.)

Obs.—Numerous portions of fronds are, I believe, referable to this fern. They possess the simple bifurcate venation that has already been recognised in similar leaves from the Leigh Creek coal-measures of central Australia,‡ and the Ipswich formation of Queensland.§ Some of the specimens exhibit a less crowded state of the venation at the apical portions of the leaves than those from the foregoing horizons.

I looked for a net-venation, thinking they might be the leaves figured by Mr. J. Stirling as *Sagenopteris Carruthersi*, McCoy,‖ whatever these may really be; but there is no more net-venation visible than in the figures referred to.

Loc.—Parish of Kongwak, Jumbunna East.

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* Saporta, Pal. Franç. Vég. Terr. Jurassique, iii., t. 27, f. 1 and 2.

† Ibid. t. 67, f. 1 and 2.

‡ Etheridge, S. Australian Parl. Papers, 1892, No. 23, p. 3, f. 1 and 2.

§ Etheridge, Geol. Pal. Queensland, 1892, p. 375.

‖ Stirling, Dept. Mines Vict., Reports on Victorian Coal-fields, No. 7, 1900, p. 4, t. 5, f. 1, 2, 2a.

Angiopteridium spathulatum, McClelland.

(Nos. 249, 250, 251, 253–55, 262, 364–67, 369, 372, 381, 406, 434, 443, 451, 461, 466.)

Obs.—The fronds of this fern are known to Victorian geologists as *Tæniopteris Daintreei*, McCoy,[*] but I still see no reason to modify my previously expressed opinion[†] that it and a form common throughout the Ipswich formation of Queensland are nothing more than local varieties of the previously described *Angiopteridium spathulatum*, McClelland. So far as the Queensland leaves are concerned, Mr. J. Shirley[‡] coincides in this view, but he considers those from Victoria to be distinct. On the other hand, Mr. W. S. Dun,[§] who has ably epitomised the whole of the Australian Tæniopteridæ, agrees with my view, and has so cogently answered Mr. Shirley's criticisms that further comment from me is wholly unnecessary.

I should not have referred to this subject had not Mr. J. Stirling[‖] revived it. It is, in my opinion, quite possible, by assembling a sufficient number of specimens from different localities, to so bridge over the apparent differences relied on by Mr. Stirling that his view of the matter simply becomes untenable. The differences between "spathulate" and "linear," or "slightly linear-lanceolate" are so small as not to warrant a separation into two species at least. If such trivial points were allowed to weigh in the determination of fossil plants, under the circumstances named, every specimen would become a species. A comparison of McCoy's original figures and Mr. Stirling's more recent drawings are sufficient to show that the width of the midrib is of little or no moment.

Amongst the Jumbunna East specimens (Nos. 372 and 451) is an interesting example of vernation. It is quite possible that this may be the young uncoiled condition of the frond of *Angiopteridium spathulatum*. A few faint striations are visible on the edges, that may indicate the veins. To speak broadly, I have little doubt that it is the vernation of an *Angiopteridium* at least.

Loc.—Kilcunda District, Jumbunna East.

Angiopteridium Etheridgei, Shirley.

(Nos. 360, 370.)

Obs.—From the Ipswich formation of Queensland Mr. J. Shirley has described[¶] a leaf, honoring me with the specific name, on the supposition that it is probably identical with a specifically undetermined form from the same formation, figured[**] by myself. On this point, however, I feel doubtful, but, be this as it may, there are two portions of leaves in the present collection that are, in all probability, Shirley's species, distinguished by their very close veins and the high angle at which they leave the midrib. They are certainly not *Angiopteridium spathulatum*, and I know no other than the above to which they bear so close a resemblance.

Loc.—Jumbunna East.

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[*] McCoy, Prod. Pal. Vict., Dec. 2, 1875, p. 15, t. 14, f. 1 and 2.
[†] Etheridge, Geol. and Pal. Queensland, &c., 1892, p. 372, 373.
[‡] Shirley, Bull. Geol. Survey Queensland, No. 7, 1898, p. 23.
[§] Dun, Proc. Austr. Assoc. Adv. Sci. for 1898 (1899), p. 392.
[‖] Stirling, Dept. Mines Vict., Reports on Victorian Coal-fields, No. 7, 1900, p. 3.
[¶] Shirley, Bull. Geol. Survey Queensland, 1898, No. 7, p. 23, t. 9, f. 1.
[**] Etheridge, Geol. Pal. Queensland, &c., 1892, p. 374, t. 16, f. 4.

Angiopteridium Tenison Woodsi, Eth. fil.

(Nos. 363, 393.)

Obs.—Two other fragments are certainly examples of the leaf to which I gave the above name.* The venation is very distinctive on ribbon-like, linear-lingual fronds, consisting of a wide midrib, giving off very oblique, wide apart, almost straight, and very distinct veins, bifurcating at about one-third from the centre of origin, and that very constantly.

Loc.—Jumbunna East.

Angiopteridium Carruthersi, Ten. Woods.

(Nos. 273, 274, &c.)

Obs.—Several portions of leaves are probably referable to this form.† It is remarkable how closely some Australian specimens resemble those figured by Dr. O. Feistmantel under this name from South Africa.‡ I believe *A. Carruthersi* is identical with the Indian *A. McClellandi*, Oldham and Morris, a point I have already called attention to. §

The bifurcation of the veins is variable in this species—some veins remain simple, others are furcate absolutely at the midrib, *i.e.*, two veins start at the same point of issue ; others immediately contiguous to the midrib, or about the middle of each frond wing ; or, again, near the frond margin ; and lastly, a vein may be twice dichotomous, but this is not common.

Loc.—Parish of Kongwak, Jumbunna East.

Sydney, 12th March, 1901.

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* Etheridge, Geol. Pal. Queensland, &c., 1892, p. 375.

† Tenison Woods, Proc. Linn. Soc. N. S. Wales, 1883, viii., Pt. i., p. 117.

‡ Feistmantel, Ubersicht Darstel. Geol.-Pal. Verhältnisse Süd. Afrikas, Theil, 1889, t 2, f. 6–10.

§ Etheridge, Geol. Pal. Queensland, &c., 1892, p 374.

2.—DETERMINATIONS OF PALÆOZOIC AND MESOZOIC FOSSILS.

(By R. Etheridge, Junr., Curator of the Australian Museum, Sydney.)

Nos. 112–144, from Sandy's Creek, below the junction with Merrijig Creek, Mitchell River (examined 13/10/98). In addition to indeterminate fragmentary plant remains, corals, crinoid stems and shells, this collection contains the following:—

**Diphyphyllum porteri*, Eth. fil., var. *mitchellensis*, var. nov.—Nos. 112, 115, 116, 117, 118, 120, 121, and 129.

**Rhizophyllum interpunctatum*, De Kon.—No. 124.

Favosites, sp.—No. 130.

**Coenites*, sp. (cast).—No. 138.

Tentaculites, sp.—Nos. 113 and 127.

Orthis (Dalmanella) elegantula, Dalman? Nos. 113 and 127.

Orthis (Schizophoria), sp. (near *O. striatula*, Schlotheim).—Nos. 125 and 143.

Orthis, sp. (near *O. vespertilis*, Sby.).—No. 126.

Pentamerus australis, McCoy?—Nos. 119, 122, 128, 132.

Pentamerus australis, McCoy.—No. 131.

Spirifera, sp.—No. 123.

Spirifera, sp., and a coral *(Monticulipora ?)*.—No. 136.

Productus ?—No. 140. I believe this specimen has been included in this collection by mistake, and that it is from the Permo-Carboniferous of New South Wales.

Strophomena or *Leptæna*.—No. 137.

Strophomena, sp.—No. 141.

Pterinea, sp.—No. 135.

No. 147, from Wando Creek, Casterton (examined 3/10/98):—Casts of plant stems or branches, probably those of a fern, but without any determinative characters. In a fine micaceous sandstone, said to be of Mesozoic age.

Nos. 148–159, from Walhalla, in shales classed as Upper Silurian (examined 7/11/98):—Fragmentary remains of vegetable life, apparently either small branches or rootlets.

Nos. 160–165, from Swamp Creek, Mitchelldale, opposite (west of) Mr. W. Websdale's house (examined 5/4/99):—

No. 160.—Portion of a *Heliolites*.

No. 161.—Conglomerate containing a few cavities left by the disintegration of crinoid stem fragments.

Nos. 162–165.—Apparently indistinct traces of plant fragments.

No. 160 may be either of Silurian or Devonian age. Nos. 161 to 165 do not afford any indication of the age of the enclosing rock.

Nos. 249–263 (examined 2/10/00), from Kilcunda and district, contained the following:—

Angiopteridium spathulatum, McClelland; *Sphenopteris crassinervis*, McCoy?; *Baiera subgracilis*, McCoy; a fragment of a conifer and part of the stem of an equisetaceous fruit.

NOTE.—Since this collection was first examined and the above report furnished, a description of the three species marked thus *, together with a minute coral (*Heterotrypa australis*, sp. nov.) subsequently detected, has been published in Progress Report of the Geological Survey of Victoria, No. XI., 1879, p. 30 *et seq.*

Nos. 264–291, from parish of Kongwak. (Nos. 264–270, from allot. 1; 271–288, from Scott's Creek; 289–291, from allot. 33c.) This collection (examined 2/10/00) contained the following:—

Angiopteridium spathulatum, McClelland (265, 270, 272, 275, 290, 291); *Angiopteridium Carruthersi*, Ten. Woods (273, 274); *Alethopteris australis*, McCoy (268); *Baiera subgracilis*, McCoy (277); *Baiera bidens*, Ten. Woods (279); *Tæniopteris* fragments (264, 266, 271, 288); leaf fragments, possibly *Phyllopteris* (269, 276); fragment of, possibly, *Podozamites* (271); and a Cordianthus-like inflorescence (267).

Nos. 292–296 (examined 2/10/00), from Outtrim railway bridge, contained *Baiera subgracilis*, McCoy (293); *Tæniopteris* (294); and a fragment resembling *Araucarites.*

Nos. 297 and 298 (examined 2/10/00), from Welshpool, contained fragmentary foliage of a conifer (297), and *Angiopteridium spathulatum*, McClelland (298).

Nos. 299–325 (examined 13/10/00), from Walhalla, included the following:—

Nos. 299–304, fossiliferous sandstone from tram cutting, west branch of Stringer's Creek, contained shell impressions and fragments, indeterminable.

Nos. 305–313, sandstone from Lady Brassey mine, Britannia spur; impressions of a small shell, probably *Rhynconella.*

Nos. 314–318, shales from Tubal Cain mine, contained possibly fragmentary plant stems, much compressed and indeterminable.

Nos. 319–325, breccia from Centennial mine, contained impressions of crinoid stem-joints and casts of minute corals, not determinable.

Nos. 326 and 327 (examined 13/10/00), from Springhurst, contained impressions and internal casts of crinoid stem-joints and brachiopod shells, including internal cast of an *Orthis;* a Palæozoic deposit.

Nos. 328–340 (examined 13/10/00), from Skene's Creek, Apollo Bay, contained *Angiopteridium spathulatum*, McClelland (328, 329, 330); *Baiera bidens*, Ten. Woods (333, 334, 335); *Baiera subgracilis*, McCoy? (337); fragment of a cupressinaceous conifer (336); lanceolate uninerved leaves, probably coniferous (338, 339); and plant fragments that cannot be satisfactorily determined, but having somewhat the habit of the genus *Cyclopitys* (340).

Nos. 341–470 (examined 12/3/01), from parish of Jumbunna East, South Gippsland, contained the following:—

Frond of *Phyllopteris* (portion).—Nos. 343, 346, 349, 397, 400, 401, 402, 412, 425, 459.

Pinnule of *Alethopteris ?*—No. 344.

Seed of *Baiera subgracilis*, McCoy ?—Nos. 348, 408, 418, 435.

Portion of a pinnule of a sphenopterid fern (*? Eremopteris*).—Nos. 353, 361, 391, 394.

Leaf with net venation (*? Sagenopteris*).—Nos. 355, 356.

Part impression of a bivalve shell, too imperfect for determination.—Nos. 357, 359.

Angiopteridium Etheridgei, Shirley.—Nos. 360, 370.

Insect wing.—No. 362.

Angiopteridium Tenison-Woodsi, Eth. fil.—Nos. 363, 392.

Angiopteridium spathulatum, McClelland (= *Tæniopteris Daintreei*, McCoy).—Nos. 364, 365, 366, 367, 369, 381, 406, 434, 443, 461, 466.

Fragment of *Albertia?* (conifer).—No. 371.

Vernation of a fern (*? Angiopteridium spathulatum*, McClelland).—No. 372.

Frond of *Phyllopteris?* (portion).—Nos. 373, 396.

Insect wing?—Nos. 374, 426.

Sphenopteris (? Eremopteris) warragulensis, McCoy, or *S. ampla*, McCoy?—No. 375.

Trichomanites (fragment of frond).—Nos. 376, 379, 383, 385, 407, 409.

Baiera subgracilis, McCoy.—Nos. 377, 380, 437, 450, 453, 457, 458, 460, 462, 464, 470.

Sphenopterid fragment.—No. 378.

Sphenopteris ampla, McCoy ? &c.—No. 382.

Sphenopterid pinnule (*? Eremopteris*).—Nos. 384, 386, 387.

Tæniopterid leaf (fragment).—Nos. 388, 390, 399, 438.

Possibly a seed or scale of a conifer.—No. 389.

Possibly a scale of a conifer.—No. 393.

Sphenopteris ampla, McCoy ?—Nos. 395, 432, 467.

Tæniopterid leaf (portion).—Nos. 403, 417.

Angiopteridium, apex of a frond.—No. 404.

Portion of a pinnule of *Sphenopteris ampla*?—No. 411.

Portion of a frond of *Sphenopteris ampla*?—No. 413.

Fragment of a tæniopterid leaf?—No. 414.

Impression of a pinnule of *Sphenopteris warragulensis*, McCoy.—No. 419.

Sphenopteris warragulensis, McCoy ?—No. 420.

Seed of *Baiera subgracilis*, McCoy, and portion of a tæniopterid.—No. 422.

Fragment of a conifer.—Nos. 428, 430.

Portion of a sphenopterid fern.—No. 429.

Sphenopteris warragulensis, McCoy.—No. 433.

Seed of *Baiera subgracilis*, McCoy.—Nos. 440, 446, 455.

Portion of a conifer (*Schizolepis?*)—Nos. 441, 448.

Portion of a sphenopterid pinnule.—No. 449.

Vernation of *Angiopteridium spathulatum*, McClelland (= *Tæniopteris Daintreei*).—No. 451.

Fragment of a conifer (*? Trichopitys*).—No. 463.

Seed of *Baiera subgracilis*, McCoy (an impression).—No. 468.

3.—PRELIMINARY REPORT ON THE FOSSIL FLORA OF PITFIELD, MORNINGTON, SENTINEL ROCK (OTWAY COAST), BERWICK, AND WONWRON.

(*By Henry Deane, M.A., F.L.S.*)

Specimens from No. 8 Bore, Glenfine Extended Company, Pitfield,* Nos. 1 to 17 inclusive. The leaves indicate a vegetation of the "brush" type; among them forms resembling *Sterculia*, *Myoporum*, *Mollinedia*, *Pittosporum*, and *Cinnamomum* are found.

Specimens from Mornington,† Nos. 18 to 33 inclusive. These remains are not well preserved, and are very difficult to make out. The living genera *Podocarpus* and *Dammara* seem, among others, to be represented. No. 30 is an interesting specimen requiring closer examination, but having all the appearance of a twig-bearing phyllodium of some species of *Acacia;* it may, however, belong to one of the parallel-veined *Eucalypti* or *Hakeæ*. I hope that further examination may lead to a decision on this point.

Specimens from Sentinel Rock,‡ Otway Coast, Nos. 34 to 76 inclusive, and Nos. 160 to 182 inclusive. These leaf remains promise very much of interest; there are many of them very well preserved, the small reticulated veins being perfectly distinct. At the present moment, however, I hesitate to express an opinion upon their affinities.

Specimens from Berwick,§ Nos. 77 to 141 inclusive, and Nos. 471 to 526 inclusive. At a first glance it would appear that nearly all traces of the original leaf structure had disappeared; a close inspection, however, shows that, in most cases, this is not so; but that while the carbonaceous matter has been either dissolved away, consumed by slow oxidation, or bleached, colorless but perfect impressions of the vein system remain. The series is remarkable for the number of leaves present resembling those of eucalypts. That leaves of this specialized type should be found in deposits recognised to be of the Eocene age is worthy of note. There are in addition other leaves which may be proteaceous; they are not unlike the leaves of the living *Lomatia Fraseri*, R. Br., but I do not at the present moment express a decided opinion upon this question. As to the likeness of the other leaves to those of eucalypts there cannot be the slightest doubt; they are a feature of this series, and when one bears in mind that the Bacchus Marsh beds—also Eocene, and therefore probably not very far removed from the Berwick deposits in point of age, geologically speaking—contain no similar leaves, one must recognise the fact as one of great significance. It shows that at that geological period, as at the present time, two classes of vegetation were growing alongside one another, namely, a "brush" type, characterized by the absence of *Eucalypti* and *Proteaceæ*, and an open forest type, in which those groups or their ancestral prototypes flourished.

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* Stanley B. Hunter, Report on the Pitfield Plains Gold-field. Special Rept. Dept. of Mines, Vict., 1901.

† A. E. Kitson, Report on the Coast Line and Adjacent Country between Frankston, Mornington, and Dromana. Month. Prog. Rept. Dept. of Mines, Vict., No. 12, March, 1900.

‡ C. S. Wilkinson, Report on the Cape Otway Country. Papers presented to Parliament, Session 1864-5, vol. IV. Map of Part of the Counties of Polwarth and Heytesbury, Cape Otway District. Papers presented to Parliament, Session 1866. A. E. Kitson, Preliminary Report on the Aire Marsh District. . . . Month. Prog. Rept. Geol. Surv. Vict., No. 10, Jan., 1900.

§ A. E. Kitson, Report on the Rapid Survey of an Area in the Berwick-Cranbourne District, with plan and section. Records of the Geological Survey of Victoria, I., Part 1., 1902.

It will be remembered that Baron von Ettingshausen, in his "Contributions to the Tertiary Flora of Australia,'' drew the conclusion that because the so-called "Australian" types were deficient among the fossils he examined, the Cainozoic flora of Australia differed essentially from the flora of the present day. In my presidential address to the Linnean Society of New South Wales on 25th March, 1896, I ventured to differ from that view, and pointed out that we should not expect to find leaves of *Eucalypti* and *Proteaceaæ* abounding in deposits formed from a "brush" vegetation ; and later, in a paper entitled "Observations on the Tertiary Flora of Australia, &c.," published in last year's proceedings of the same society, I further explained the attitude I had taken up. The facts now brought forward are of value as bearing on this controversy.

It is to be hoped that fruits of the trees which bore the eucalypt-like leaves may be found in the Berwick deposits. The question might thus be settled whether the evolution of the genus *Eucalyptus* had at that time already taken place. It must not be overlooked that two of the species of the closely allied genus *Angophora*—namely, *A. intermedia*, D.C., and *A. lanceolata*, Cav.—have leaves quite like those of *Eucalyptus*, so that it could not with certainty be asserted that the leaf remains in question indicate the existence of *Eucalyptus* rather than that of *Angophora*. They might be either, or they might have belonged to a common ancestor of both genera.

Specimens from Middle Creek, Wonwron, near Yarram,* Nos. 142 to 159 inclusive. These are not by any means easy to determine; the structure of most of the leaves is not at all clear, but I hope that further and closer examination may result in the affinities of some of them, at least, being determined.

I venture to make some suggestions as to the preservation of specimens against drying up and falling to pieces. It is essential that the fluid used for coating them should be such as not to obliterate the delicate texture of the leaf tissues. I believe it has been a common practice in various centres to use fish glue or some kind of varnish, but such substances render the finer markings invisible. I would suggest to geologists that vaseline be experimented with. I have in my possession some leaf impressions in a white clay deposit similar to those from Berwick. I coated them over with vaseline soon after obtaining them, and they are just as perfect as when I got them, and the leaf impressions are without the objectionable glaze. If the effect of the vaseline tends to pass away—which at present I have not observed—it will be very easy to dip them again in warm and liquid vaseline and carefully wipe or brush off the surplus that adheres.

Hunter's Hill, Sydney, 8th June, 1901.

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* A. E. Kitson, Report on Lignite at Wonwron. Records of Geological Survey o Victoria, I., Part 1, 1902.

4.—NOTES ON THE FOSSIL FLORA OF PITFIELD* AND MORNINGTON.†

(*By Henry Deane, M.A., F.L.S.*)

Notes on specimens Nos. 1 to 17 inclusive, marked as follows:—Glenfine Extended Co., Pitfield Plains, No. 8 bore, 100 feet from surface, under two distinct layers of basalt, resting on basalt.

Further examination of these specimens confirms the opinion expressed in my preliminary report of the 8th June last, that the leaves indicate a vegetation of the "brush" type. From the following descriptions and observations it will be seen that there is nothing to suggest the existence of any element from outside, but that, on the contrary, the vegetation as shown in the fossils was truly Australian in character.

In the following I have made references to all the specimens submitted to me except No. 17, which shows too small a portion of leaf for identification. It is, however, of the *Cinnamomum* type.

STERCULIACEÆ.

Sterculia Muelleri, sp. nov.

Plate I., Fig. 1.

Leaf (to judge from the portion preserved) evidently trilobate, several inches in length and width. Primary veins three in number, straight, stout, radiating from the base; a fourth vein, slightly curved and much shorter, which might almost be included as a primary vein, is to be seen near the margin of the leaf on the right side slanting from the same point at an angle of about 45° with the middle one. Secondary veins well defined, long, curved, and branching off the primary veins. The tertiary system consists of shorter veins proceeding at right angles, or nearly so, to the primary veins, finally curving and meeting the adjacent ones or those proceeding from the other primary veins. Finer reticulated veins faint.

The portion of leaf preserved in specimen No. 1 possesses the type of venation characteristic of *Acer*, *Platanus*, *Sterculia*, *Aleurites*, &c. There can be no reason for discarding *Sterculia* in favour of a northern temperate genus such as *Acer*, as Baron von Ettingshausen, in his "Contributions to the Tertiary Flora of Australia," has shown an inclination to do, especially as the indigenous genus mentioned completely answers the conditions.

Sterculia diversifolia, G. Don., has sometimes trilobate leaves, and the basal vein which exists in the fossil leaf is then found. The leaves of *Sterculia acerifolia*, A. Cunn., are generally 5-lobed, but they frequently have the lobes reduced to three, and the outer ribs are then found to be reduced to shorter basal veins, like the one in the fossil. The finer veins of the fossil leaf can only be seen when closely examined, but they are correctly represented in the figure. The specimen shows a groove or fold in the deposit which has nothing to do with the venation, and it has been left out of the drawing in order to avoid confusion.

Specimen No. 4 is evidently the reverse or cover of No. 1.

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* Stanley B. Hunter, Report on the Pitfield Plains Gold-field. Spec. Rept. Dept. of Mines, Vict., 1901.

† A. E. Kitson, Report on the Coast Line and Adjacent Country between Frankston, Mornington, and Dromana. Month. Prog. Rept. Geol. Surv. Vict., No. 12, March, 1900, p. 11.

MAGNOLIACEÆ.

Drimys ?

Plate I., Fig. 2.

Leaf narrow rhomboidal, originally about 3 inches long, base and apex tapered, midrib strongly developed. Lateral veins evidently merged in a somewhat fleshy lamina, and thus not distinguishable.

The leaf described is preserved in specimen No. 2, the apex alone is lost. It is extremely difficult to even guess at its affinities. It is one, however, which should be named for purposes of record, and I have provisionally named it as above. The shape agrees with some leaves of *Dodonæa triquetra*, Wendl., but if that species were found in the fossil state the lateral veins would be nearly as distinct as the midrib. The outline is not unlike some species of *Persoonia*. The tapering at each end of the leaf is a character which perhaps corresponds with *Drimys* more than any other genus. It is hoped that further discoveries may help to solve the difficulty.

Specimen No. 12 exhibits the reverse or cover of No. 2.

SAPINDACEÆ.

Nephelites Ulrichi, sp. nov.

Plate I., Fig. 3.

Fragment, apparently that of a pinna of a large leaf. Midrib stout and straight. Secondary veins well marked, forming an angle of from 45° to 60° with the midrib, slightly curved. Tertiary system consists of reticulated veins. Margin of leaf toothed, the two sides unequal, and thus having the character of a pinna of a large leaf.

In specimen No. 3 portions of two leaves are present. The one in question is that on the unvarnished side. Although badly preserved, I have thought it right to place it on record. The leaf may be included under my genus *Nephelites**, and, as such, is interesting, as it would indicate the former existence of the pinnate-leaved *Sapindaceæ* in this part of Victoria. It is hoped that other specimens may be forthcoming.

Specimen No. 14 is evidently the reverse of No. 3.

MONIMIACEÆ.

Mollinedia Muelleri, sp. nov.

Plate I., Fig. 4.

Leaf about 3½ inches in length and 1¼ inches in width, somewhat lop-sided. Leaf ovate, with wavy or slightly-toothed outline. Venation well marked, midrib straight; secondary veins starting nearly at right angles to the midrib, every alternate one before reaching the margin curving round and meeting the next above; intermediate ones shorter, and with the tertiary veins, which branch from them, and the larger secondary veins dividing up the surface of the leaf into a coarse network.

The leaf, a large part of which is particularly well preserved in specimen No. 5, has a very great resemblance to the leaves of the existing *Mollinedia macrophylla*, Tulasne, and except that it is smaller than the average of that plant might almost be taken for it. That the leaf grew on a tree of the natural order *Monimiaceæ* is highly probable. The general arrangement of the principal veins and the character of the smaller reticulated veins are quite those of *Mollinedia*. The margin is slightly broken in outline, apparently dentate, but perhaps a little less so than shown in the figure, which has been otherwise very carefully drawn.

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* Deane, Notes on Fossil Leaves from the Tertiary Deposits of Wingello and Bungonia. Records Geol. Surv. N.S.W., Vol. VII., Pt. 2, 1902, p. 60.

The impression in reverse of this specimen, No. 5, is shown on the varnished side of No. 3; the depressions or grooves with which the surface is marked, and which seem to indicate the presence of veins, are mere irregularities of the surface.

Daphnandra Selwyni, sp. nov.

Plate I., Fig. 5.

Well-preserved leaf, 1½ inches long and ¾ inch wide, ovate, with the margin slightly crenulate or bluntly serrate. Midrib straight, lateral veins curved and nearly reaching the margin, but then branching, the upper branch turning round to meet the lower branch of the next above; tertiary veins forming a network between the lateral veins.

Specimen No. 6 displays a leaf which calls for remarks very similar to those made with respect to *Mollinedia Muelleri*. If there is any reliance at all to be placed on fossil leaf nomenclature, the leaf in question may be considered to belong to the natural order *Monimiaceæ*, and of the included genera it most resembles *Daphnandra*.

Specimen No. 8 is the reverse or cover of No. 6.

Cinnamomum polymorphoides, McCoy.

Plate I., Figs. 6 and 12.

The leaf fragment preserved in specimen No. 7 (Fig. 6) resembles the late Professor McCoy's *Cinnamomum polymorphoides*, and I have assumed it to be this species. I have called attention elsewhere (Proceedings of the Linnean Society of New South Wales) to the fact that this type of venation is not confined to *Cinnamomum*, and that no argument can be based on the reputed existence of *Cinnamomum* as indicating an Indian element in the flora. Species of *Cinnamomum* flourish to-day in New South Wales and Queensland, and the type exists in Australian species of other genera of *Laurineæ*, such as *Litsæa*, *Cryptocarya*, and in some degree *Endiandra*.

Specimen No. 15 (Fig. 12) exhibits a portion of a leaf possessing apparently the *Cinnamomum* venation. The principal veins remind one of the way in which those of *Acacia binervata*, De Can., branch out, but there are apparently some small veins on the right hand side, as shown in the figure, which do not support such a determination, but tend rather to indicate affinity to *Cinnamomum*. As the identity is not very certain, it may be better to place the fossil provisionally under *C. polymorphoides*. The discovery of further specimens from the same horizon may settle the matter.

SAXIFRAGEÆ.

Argophyllites parvifolia, sp. nov.

Plate I., Fig. 7.

Leaf originally about 4 inches in length, probably ovate lanceolate in outline, with well defined but distant teeth, apex and base not preserved. Midrib straight, and straight lateral viens almost in pairs opposite one another, curved, and reaching the margin at the points of the teeth. The tertiary venation consists of a network of smaller veins, which chiefly arrange themselves in lines at right angles to the midrib.

The figure is taken from the portion of leaf preserved in specimen No. 9. The tertiary venation is unusual. In this respect *Cutsia viburnea*, F. v. M.

(*Saxifrageæ*), may be compared. There is also a resemblance to *Leea* and some *Ampelidæ*. The leaf has a good deal of the character of some leaves of *Vitis antarctica*, Benth., a rather variable species, with larger and broader leaves and coarser venation than the fossil. On the whole, I consider that its affinities lie more with the *Saxifrageæ* than with any other group. In general form and character it may be compared with *Argophyllites levis*, H.D., from Wingello, New South Wales,* and I have, therefore, named it as above, the specific name being given on account of its small size.

Eucryphia Gregorii, sp. nov.

Plate I., Fig. 9.

Leaf or pinna narrow, ovate, obtuse, about 2 inches long and about ¾ inch wide. Midrib well marked, lateral veins rather numerous, placed at an angle of about 60° or 70° with the midrib, losing themselves in the substance of the leaf before finally reaching the margin.

The leaf figured in this is specimen No. 11. It bears such a striking resemblance to a pinna of *Eucryphia Moorei*, F. v. M., of New South Wales and Victoria, and to a leaf of *E. Billardieri*, Spach., of Tasmania, that I feel justified in including it under the same genus.

ARALIACEÆ.

Genus Panacites, gen. nov.

This genus is intended to include leaves similar to those of certain species of the living genus *Panax*, of which *P. Gunnii* is the type. The leaves are of a somewhat delicate or soft texture, probably digitate with three or five leaflets, the venation of the leaflets pinnate with the lateral veins running out towards the margin—the leaflets are lanceolate in shape and the margins toothed or sinuate.

Panacites Howitti, sp. nov.

Plate I., Fig. 8.

Leaf or pinna slightly over 1½ inches in length, and about ⅝ inch broad; slightly lopsided, with bluntly dentate or sinuate margins. Midrib slightly undulate, lateral veins somewhat numerous, slightly curved, making an angle of about 40° or 45° with the midrib, and terminating at the teeth.

The fossil here described is preserved in specimen No. 10. It would be very easy to refer this leaf to *Quercus*, and if that were done it would only be following the example of Ettingshausen in his Contributions to the Tertiary Flora of Australia. It is, however, extremely unlikely that the genus *Quercus* should have flourished during the early Cainozoic in south-eastern Australia, and afterwards become exterminated. It is far safer to look to other and indigenous genera for affinities.

The form and character of the leaf in question can, I consider, be found under the genus *Panax*, species of which flourish in eastern Australia and New Zealand, and which has a representative at the present day in Tasmania. This idea of *Panax* as an eastern Australian genus would probably be derived from such species as *P. sambucifolius*, *P. elegans*, *P. Murrayi*, &c., but there are other types more to the purpose. *Panax Gunnii*, J. Hooker, a Tasmanian species, has delicate trifoliolate leaves, very variable in shape, and some forms of the leaflets are very like the fossil, being irregularly dentate, and with the lateral veins generally only slightly conspicuous, but extending to the points of the teeth. If we wish to see to what extent the leaves of this genus may tend to vary, it is instructive to compare some of the toothed forms of the leaves of the New Zealand species *P. Edgerleyi* (see Kirk's Forest Flora of New Zealand), and also *P. simplex*, and some, by no means unlike the fossil, will there be seen. There is acknowledged to be a floral element in south-eastern Australia and Tasmania which is common to New Zealand, and its existence in those countries at the present time seems to indicate a former land connexion of some kind, possibly in the early Cainozoic, and it is not, therefore, an extravagant step to take in seeking for near allies for the fossil in New Zealand.

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* Deane, *op. cit.*

It will be seen that I assume that the leaf before us may be a pinna, not a complete leaf. Its unsymmetrical and lopsided shape lends credence to that view. If the other lobes of the supposed trifoliolate leaf had been preserved, I should have no hesitation in including the fossil under the genus *Panax*. Under the circumstances I prefer to place it under a new genus *Panacites*.

PITTOSPOREÆ.

Pittosporum præundulatum, sp. nov.

Plate I., Fig. 10.

Leaf originally about 4½ inches long, 1¼ inches wide, ovate, lanceolate, tapered at base with entire margin. Midrib well marked, longer lateral veins clear but not prominent, leaving the midrib at an angle of from 60° to 70°, slightly curved and not reaching the margin, intermediate shorter ones visible ; tertiary veins not conspicuous. Leaf smooth.

The shape and apparent texture of the leaf, the character of the venation, and the arrangement of the lateral veins, forcibly remind one of *Pittosporum undulatum*, Andrews, and it is in recognition of this fact that I have named the leaf.

Carpolithes acaciæformis, sp. nov.

Plate I., Fig. 11.

Specimen No. 16 contains a fossil seed, orbicular in outline and somewhat flattened. There is nothing specially definite about it, but it seems desirable to place it on record; and as the form is similar to some *Acacia* seeds, I have named it as above.

Specimens from Mornington, Nos. 18 to 33 inclusive :—

The leaves generally are not sufficiently well preserved to enable any certain conclusion to be drawn from them, and I have found only one specimen to be suitable for description and figuring. There are several, however, worthy of remark, because, although the state of preservation is not sufficiently good for accurate determination, their affinities are clear enough and worth recording as proving the class of vegetation which was growing at the time. With regard to others, such as No. 18, the condition is tantalizing ; one feels very much tempted to guess at their affinities, but it is doubtless safer to wait for further specimens.

No. 19 shows portions of dicotyledonous leaves, one of which has pinnate veins and crenulate margins. There is a suggestion of *Daphnandra*, but it would be hazardous to express a decided opinion.

No. 21 contains undoubtedly a branchlet of a conifer, either a small leaved *Podocarpus* or an ally, but the definition is not good.

No. 23 shows something similar to the last.

No. 24 contains a branchlet of what is probably a *Podocarpus* with small acute leaves like the existing New Zealand *P. totara*. Ettingshausen has figured such a small-leaved plant in his Contributions to the Tertiary Flora of Australia, Plate VIII., and named it *P. præcupressina*. The structure of the fossil in question is, however, not so well defined.

No. 30 is worthy of special mention. It is particularly interesting. I have figured and named it as follows :—

MYRTACEÆ.

Eucalyptus præcoriacea, sp. nov.

Plate II.

The figure shows portions of branchlets with leaves attached. Branchlets evidently angular. Leaves almost sessile, lanceolate, falcate, probably 6 inches in length and 1 inch wide, tapered at the base into a short petiole. The venation consists of several veins disposed longitudinally, no one of which can be said to form a midrib. Some of these veins are more conspicuous than the others.

There are three types which naturally suggest themselves as possessing leaves with parallel veins, as shown in the figure, namely, the phyllodineous *Acaciæ*, some of the *Hakeæ*, like *H. dactyloides*, Cav., and *Eucalyptus coriacea*, A. Cunn. I have carefully compared the fossil with these types, and I have convinced myself that it approaches most nearly to *Eucalyptus coriacea*. The fossil leaves are very oblique at the base, they have numerous parallel veins, without any, or much sign of any, anastomosing veins between them. The *Hakea* and *Acacia* leaves nearest in character are not oblique at the base, and the anastomosing veins are rather a feature. I am, therefore, of opinion that we have a branchlet here of a species of *Eucalyptus* of the group *Renanthereæ*, and allied to *E. coriacea*. Should this conclusion be borne out by later discoveries, it means that at the period when the Mornington beds were deposited the different groups of eucalypts had already become differentiated. In naming this fossil I felt at first very much disposed to invent a new genus for it, as another genus, namely, *Angophora*, has eucalyptus-like leaves, and probably had with the modern *Eucalyptus* a common ancestor; but I thought, on maturer consideration, that if the remarkable differences in leaf venation had already arisen, the genus *Eucalyptus* had probably also already been evolved. The different kinds of leaf venation in eucalypts are referred to in a paper read by me before the Linnean Society of New South Wales, Vol. for 1900, p. 581, and figured diagrammatically in Plate XXXVI. At one end of the series is the parallel-veined type, at the other the type characterized by having the secondary veins almost transverse.

DESCRIPTION OF PLATES.

PLATE I.

Fig. 1. *Sterculia Muelleri*, sp. nov. (Spec. No. 1).
Fig. 2. *Drimys ?* (Spec. No. 2).
Fig. 3. *Nephelites Ulrichi*, sp. nov. (Spec. No. 3).
Fig. 4. *Mollinedia Muelleri*, sp. nov. (Spec. No. 5).
Fig. 5. *Daphnandra Selwyni*, sp. nov. (Spec. No. 6).
Figs. 6, 12. *Cinnamomum polymorphoides*, McCoy (Specs. Nos. 7, 15).
Fig. 7. *Argophyllites parvifolia*, sp. nov. (Spec. No. 9).
Fig. 8. *Panacites Howitti*, sp. nov. (Spec. No. 10).
Fig. 9. *Eucryphia Gregorii*, sp. nov. (Spec. No. 11).
Fig. 10. *Pittosporum præundulatum*, sp. nov. (Spec. No. 13).
Fig. 11. *Carpolithes acaciæformis*, sp. nov. (Spec. No. 16)

PLATE II.

Eucalyptus præcoriacea, sp. nov. (Spec. No. 30).

Hunter's Hill,
Sydney, 6th September, 1901.

5.—NOTES ON THE FOSSIL FLORA OF BERWICK.*

(*By Henry Deane, M.A, F.L.S.*)

(Specimens 77–141, 228–283.)

A large number of the leaves from these deposits have all the appearance of eucalypts, and that they belong to the genus *Eucalyptus* as we know it, and not merely to some ancestral form, is highly probable. I pointed out with regard to *E. præcoriacea*, from the Mornington deposits, that that species possessed a type of venation corresponding with *E. coriacea*, A. Cunn. (*E. pauciflora*, Sieber), second in the series given in the late Baron von Mueller's Census.† This latter species and *E. stellulata*, Sieber, have parallel veins, while the rest of the group of *Renantheræ* have veins forming a more or less acute angle with the midrib. Towards the end of the whole series which terminates with the *Parallelantheræ* the lateral veins are more transverse. Some of the fossil leaves possess this latter character, while some are intermediate in the angle they form with the midrib. I think it is now clear that nearly all the varieties of venation displayed by the living genus were to be found in the early Cainozoic, so that perhaps it may fairly be concluded that the other characters of the genus had been differentiated.

The naming of fossil eucalypt leaves is a difficult task, and in the end the names can be only conventional. Each name is applied to a particular form of leaf, but that form may have been common to several species, as is often found to be the case at the present day. It must be borne in mind, therefore, that we are not dealing with species determined after the examination of a series of botanical characters, but only with differences in leaf form and venation. Leaves may be thought to be identical that really belong to quite different species, and, perhaps, to other genera and natural orders. It would be far preferable, except in cases where all probability of doubt is removed, to adopt some nomenclature by which it would be understood that the leaf and leaf only is the guide. In the present case a new compound name might be suggested. As, however, Professor McCoy, Baron Ettingshausen, and Mr. R. M. Johnston have already referred Australian and Tasmanian fossil leaves to the living genus, and as the probability of the existence of Eucalypts in the early Cainozoic is, as already explained, exceedingly great, I feel that it would be pedantic on my part to adopt any other method than that used by those authorities. Similar remarks would be applicable with reference to other genera, such as *Fagus*, *Lomatia*, &c.

Besides the above typical Australian forms there are others also occurring in these deposits which appear to be eminently Australian in character. There are many leaves which seem to be only referable to *Proteaceæ*, and some of these very much resemble certain species of *Lomatia*, identified as such by Baron Ettingshausen in his Contributions to the Tertiary Flora of Australia. The southern *Fagus* seems also to be represented, as well as *Mollinedia*, *Daphnandra*, and some others which are present in the vegetation of south-eastern Australia at the present day. There is no necessity to search among the floras of other parts of the world for the affinities of these Berwick fossils. This is a very interesting fact, as it seems to show that at the time these deposits were laid down, the flora of the district from which the leaves were derived was as typically Australian as that of any district at the present day.

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* A. E. Kitson, Report on the Rapid Survey of an Area in the Berwick-Cranbourne District.—Rec. Geol. Surv. Vict., I, Pt. 1, 1902.

† Deane, Notes on the Fossil Flora of Pitfield and Mornington. *Ibid.*

There are some leaves which I have thought worth figuring, but, on account of their imperfect condition, not good enough to name, as their affinities are consequently uncertain. They are as follow :—

Specimen No. 82, shown on Plate V., Fig. 12, suggests *Dammara.* Specimen No. 250, Plate VI., Fig. 8, may be *Tristanites.* No. 124, Plate VI., Fig. 10, suggests *Nephelites.*

Among some specimens furnished by Mr. T. S. Hall, M.A., of the Melbourne University, obtained from Wilson's quarry, Berwick, there are two specimens specially worthy of notice ; one has a remarkable resemblance to *Fagus Hookeri,* Ett., from Vegetable Creek, New South Wales. (Contr. Tert. Fl. Austr., Pl. X., Fig. 11) ; the other is that of a eucalypt-like leaf, of ovate and nearly symmetrical shape, with the principal lateral veins wider apart than usual, and with the intramarginal vein at a distance from the margin.

DICOTYLEDONEÆ.

POLYPETALÆ ?

TILIACEÆ.

Aristotelia, sp. nov. ?

Plate V., Fig. 10.

On specimen No. 273 is preserved a leaf, the margins of which are not too well defined. Some fresh unvarnished specimens might suggest a different determination, but as far as one can judge from the appearance of the leaf as it exists, the margin towards the apex, which appears to have been lanceolate acuminate, is finely toothed, strongly resembling some specimens in my possession of *Aristotelia pedunculata,* J. Hooker, from Tasmania. It may therefore be convenient to provisionally include it in that genus.

STERCULIACEÆ.

Commerconia, sp. nov. ?

Plate VI., Fig. 1.

The fragment preserved in specimen No. 120 has all the characters of the tips of a *Commerconia* leaf ; I can see no objection to including it provisionally in that genus. Further discoveries may prove it to have other affinities, but till that occurs it is convenient to include it under the above genus, which has representatives in eastern Australia at the present day.

DISCIFLORÆ.

SAPINDACEÆ.

Nephelites quercifolia, sp. nov.

Plate V., Fig. 11.

Portion of a leaf or pinna, evidently about 1¾ inches in length, ovate, almost rhomboidal, oblique, margins irregularly dentate, sinuate, or crenate. Midrib well marked, slightly curved, lateral veins proceeding from the midrib on the right side at a larger angle than on the left.

I have taken the leaf contained in specimen No. 256 to be a pinna of a compound leaf, and as the Sapindaceæ contain leaves of similar characters, I have included it under my genus *Nephelites.* I know of no fossil leaf described and figured which resembles this one. Some of the forms of the leaflets of *Panax Gunnii,* J. Hooker, a Tasmanian species, are not unlike the specimen.

Nephelites Berwickense, sp. nov.

Plate VI., Fig. 9.

Portions of a leaf ovate or ovate lanceolate, entire. Midrib straight and well marked, lateral or secondary veins conspicuous, curved; those on the right hand side proceed at a wider angle with the midrib than those on the left. In this it resembles the pinna of the leaves of *Nephelium*, *Cupania* and other genera.

The lopsidedness of the leaf preserved in specimen No. 84 appears to indicate that it is a pinna of some large leaf, and I have included it under my genus *Nephelites*.

CALYCIFLORÆ.

MYRTACEÆ.

Tristanites, gen. nov.

This name is adopted on account of the resemblance of certain leaves to those of the different species of the existing genus *Tristania*, R. Br.

The characters are those of *Tristania*. The leaves are ovate to linear lanceolate, entire; midrib well marked and straight; lateral or secondary veins conspicuous, starting at an acute angle from the midrib, and curving round before reaching the margin, where they generally seem to lose themselves in the substance of the leaf, but in reality pass upwards and join the next lateral vein. These outer portions of the lateral veins which produce the appearance of an intramarginal vein in *Myrtaceæ* are not generally conspicuous in this genus.

Tristanites angustifolia, sp. nov.

Plate III., Fig. 1; Plate VI., Fig 7.

Leaf about 2¼ inches in length and ⅔ inch in width, lanceolate obtuse, base slightly oblique, entire. Midrib strongly marked; lateral veins starting from the midrib at an angle of about 60°, curved and nearly reaching the margin; smaller veins not visible.

The leaf described is preserved in specimen No. 77, and it might at first sight be taken for *Eucalyptus*, but this similarity disappears on close examination. There is an absence of the finer lateral and reticulated veins to be seen in those species which at all resemble the leaf in question. The leaf resembles the leaves of *Tristania nereifolia*, R. Br., and *T. laurina*, R. Br. That contained in specimen No. 115, and shown in Plate VI., Fig. 7, appears to belong to the same species.

Tristanites Muelleri, sp. nov.

Plate III., Fig. 2.

Leaf about 4 inches in length, rather more than ¾ inch wide, lanceolate, entire. Unfortunately, the apex is lost and the base not quite intact. Midrib strongly marked and straight. The lateral or secondary veins very distinct, distant from one another, curved, losing themselves on approaching the margin. Finer reticulated veins not visible.

The leaf described is contained in specimen No. 79. Although somewhat narrower, it follows in the main the type of *Tristania conferta*, R. Br., and *T. suaveoleus*, Smith. There is an indication at one part of an intramarginal vein, which lends all the greater probability to the view that this leaf belongs to the *Myrtaceæ*. Specimen No. 231 contains a similar leaf.

Eucalyptus Mitchelli, Ett.

Plate III., Figs. 5, 6, 7, and 8.

Certain fragments of leaves appear to have the characters on which Ettingshausen described this species. (See Contr. Tert. Fl. Aust., Pl. XV., Figs. 6 to 8.) Those contained in specimens Nos. 81, 85, 86, and 92 are the ones figured; other examples occur in specimens Nos. 93 and 251.

Eucalyptus Houtmanni, Ett.?

Plate IV., Fig. 1.

One of the leaves preserved in specimen No. 260 corresponds in some important points with the species thus named and figured by Ettingshausen (Contr. Tert. Fl. Aust., Pl. XV., Fig. 3); the lateral veins make a wide angle, say 70°, with the midrib, and they are rather wide apart, as in that species. It is to be observed, however, that Ettingshausen's figure shows an almost symmetrical leaf, whereas the leaf here referred to is as broad again on one side as the other, and it is very oblique at the base. I consider it safer to wait for further material before making a new species.

Eucalyptus Howitti, sp. nov.

Plate III., Fig. 10; Plate IV., Fig. 2.

Leaves oblique, almost cordate at base, lateral veins transverse, intramarginal vein conspicuous.

The leaves preserved in specimens Nos. 271 and 89, to which I have given the above name, after Mr. A. W. Howitt, possess characters which have not hitherto been noticed in fossil eucalypts. They can, no doubt, with safety be referred to the genus, as the texture of the leaf is of the right character and the intramarginal vein is quite eucalyptus-like. They seem, however, to belong to species with opposite leaves, or to be leaves of seedlings or suckers, these being often cordate or rounded at the base.

Eucalyptus Woollsii, sp. nov.

Plate III., Figs. 4 and 9.

Leaf lanceolate, attenuate at base, almost straight and symmetrical, only slightly oblique at base. Midrib strongly marked; lateral veins close together, making an angle of about 40° with the midrib. Intramarginal vein rather close to the margin.

The leaves figured are those contained in specimens Nos. 260 and 95; specimen No. 98 contains a similar leaf. They closely resemble those described by Ettingshausen as *E. Hayi* (Contr. Tert. Fl. Aust., Pl. XV). It is to be noted, however, that the lateral veins of *E. Woollsii* are closer together than those of *E. Hayi*, and the leaves are not so attenuate at the base. I have therefore decided to give these leaves specific rank, and have named them after the late Rev. Dr. Woolls, well known for his investigations of this difficult genus.

Eucalyptus Muelleri, sp. nov.

Plate III., Fig. 3.

Leaf broadly lanceolate, falcate, much attenuate at base; lateral veins rather close, parallel, and inclined to the midrib at an angle of about 45°. Intramarginal vein close to the margin.

The leaf from which the description is taken is preserved in specimen No 78. It represents the lower part only of a leaf which, if perfect, would be several inches in length. It is not unlike *E. Woollsii*, described above, in venation, but differs from that species in being strongly falcate, and in its more attenuate base.

Eucalyptus Hermani, sp. nov.

Plate IV., Figs. 3 and 4.

Leaves evidently long and linear, scarcely falcate. Lateral veins very fine, close, and parallel, and meeting the midrib at an angle of from 60° to 65°. Intramarginal vein close to the margin.

The leaves agree as to the angle of the lateral veins with *E. Mitchelli*, Ett. (Contr. Tert. Fl. Aust., Pl. XV., Figs. 6, 7, 8), but they are closer together; the leaves are also narrower and longer in proportion. The description and figures are taken from specimens Nos. 80 and 81.

Eucalyptus Kitsoni, sp. nov.

Plate IV., Figs. 5, 6, and 7.

Leaves long and linear, probably 5 inches in length and $\frac{5}{8}$ inch in width, nearly straight. Lateral veins proceeding from the midrib at an angle of about 40°, close together, straight and parallel. Intramarginal vein close to the edge.

The leaves from which the above descriptions are drawn are preserved in specimens Nos. 257, 276, and 256. They are, unfortunately, portions only, but there is sufficient of them preserved to show their true character. At first sight they resemble *E. Hermani*, *supra*, but they are easily distinguished by the acute angle, 40°, at which the lateral veins leave the midrib as compared with that other species, where the angle is 60° to 65°. They also resemble *E. Hayi*, Ett. (Contr. Tert. Fl. Aust., Pl. XV.), but they are longer and narrower than in that species, and the lateral veins are much closer.

MONOPETALÆ.

Apocynaceæ.

Apocynophyllum Berwickense, sp. nov.

Plate VII., Fig. 11.

Leaf, lower half of which only is preserved, probably lanceolate with attenuate bases from 3 to 4 inches long. Midrib flexuose, stout; lateral veins stout at their junction with the midrib, but becoming rapidly thinner, starting from the midrib at a wide angle, then becoming more inclined. Leaf smooth.

The description is that of the fragment of leaf contained in specimen No. 110. The venation is not unlike that of *Duboisia myoporoides*, R. Br., but the taper of the leaf and the way in which the lateral veins branch out of the midrib are strongly characteristic of *Solanum vescum*, F. v. M.; and except that the lateral veins in the specimen under review are closer together, and that the texture of the leaf was probably stouter, it might well have grown on an allied species of *Solanum*.

On mature consideration I think it better to include the leaf under *Apocynophyllum*. It has points of resemblance with *Apocynophyllum Warburtoni*, Ett., from Vegetable Creek (Cont. Tert. Fl. Aust., Plate XIII., Fig. 8), and also to *A. travertinum*, Ett., from the Derwent district, Tasmania (*Ibid.*, Plate IV., Fig. 6), which, however, I have not been able to see.

The venation is also not unlike that of *Tabernæmoutana*, of the natural order *Apocynaceæ*. It is, therefore, on the whole advisable to place the leaf as stated, and not to multiply genera.

MONOCHLAMYDEÆ.

MONIMIACEÆ.

Atherosperma Berwickense, sp. nov.

Plate VII., Figs. 1, 2, and 3.

Leaf from 1¼ to 1½ inches or longer, rhomboidal in shape, more or less oblique, especially at the base, the margins bluntly dentate. Midrib strongly marked, curved ; lateral or secondary veins conspicuous, running out towards the teeth, nearly straight, about 40° to the midrib. Tertiary venation reticulate, with a tendency to an arrangement more or less at right angles to the secondary veins, not very conspicuous, being apparently immersed in a leaf of somewhat leathery consistence.

The above description is taken from the leaves shown in specimens 99, 109, and 244, the two former being basal fragments only, the latter a complete leaf. They seem to approach nearer to *Atherosperma* or *Doryphora* in character than to any other genus or group. *Atherosperma* leaves are not infrequently curved, though not in so pronounced a manner as some of the fossil leaves show, but the character exists. The arrangement of the lateral veins and the teeth of the margin are perhaps more like what occur in *Doryphora sassafras*, Endl., than is generally the case with *Atherosperma moschata*, Lab. I have, however, observed some leaves of the latter species which quite meet the case. There is a slight resemblance to the leaves of *Orites Milligani*, Meissner, a Tasmanian protead, but the teeth are acute and further apart than in the fossil leaves here.

The leaf contained in specimen No. 253 has some points in common with the above, but the serrations of the margin are finer, and the characters generally are more those of *Fagus*. I have placed it under Ettingshausen's *Fagus Muelleri* from Vegetable Creek (Cont. Tert. Fl. Aust., Pl. X., Figs. 3–7).

Mollinedia helicioides, sp. nov.

Plate VI., Fig. 5.

Leaf probably 4½ or 5 inches in length, ovate or ovate lanceolate, 2 inches wide, margin slightly sinuate, and with sharp points or teeth about a line long. Midrib stout, lateral or secondary veins starting at various angles from nearly 90° to about 45° with the midrib, curving round before reaching the margin and ultimately joining the next above. Tertiary veins forming a coarse reticulation, but arranged chiefly when near the midrib at right angles to it, and further out in the lateral veins at right angles to them. Final reticulation not so conspicuous. Texture apparently coriaceous.

There can, I think, be little doubt of the relationship of the leaf in question, which is preserved in specimen 242. It has the general character of the *Monimiaceæ*, and approaches more nearly to some existing species of *Mollinedia* than to those of any other genus. It is evidently allied to, though specifically quite distinct from, *Mollinedia Muelleri*, described by me in my notes on the Pitfield specimens (see No. 5).* The small sharp teeth form a character which is shared with the existing *M. Huegeliana*, Tulasne, and also *Helicia ferruginea*, F.v.M., and I have made use of its resemblance to the last-named genus to make the specific name.

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* Deane, *op. cit.*

Mollinedia prælongipes, sp. nov.

Plate VI., Fig. 4.

Leaf ovate or ovate lanceolate, probably about 4 inches in length and 1½ inches broad, with slightly undulate margins. Midrib straight and well defined. Lateral or secondary veins starting from the midrib at varying angles, and sometimes in pairs, ultimately curving round and meeting the next above. The anastomosing of these veins leads to the appearance of a well defined wavy intramarginal vein. Tertiary venation not conspicuous.

The leaf above described is preserved as a fragment in specimen No. 270. On first examination, it is not altogether unlike some seedling eucalypt leaves, or those from suckers or adventitious shoots. These possess an arrangement of the venation somewhat similar to the leaf in question, but a closer investigation shows that the leaf belongs probably to some plant of the order *Monimiaceæ*, and most probably to *Mollinedia*, under which I have therefore placed it. Its most remarkable characteristic, which is the tendency for the lateral veins to leave the midrib in pairs, is shared with the existing *M. longipes*, Benth.

Hedycarya latifolia, sp. nov.

Plate VI., Fig. 3.

Leaf ovate or rhomboidal, tapering towards the base, margins bordered with irregular teeth, midrib strongly marked and straight, lateral or secondary veins starting from the midrib at an angle of about 45°, and curving slightly as they proceed outwards, finally meeting the next above; tertiary venation coarsely reticulate, the more strongly marked veins arranging themselves more or less at right angles to the secondary veins. Finer reticulation not conspicuous.

The specimen from which the above description is drawn is No. 128. It is rather difficult to decide whether the venation more nearly resembles that of the species of *Hedycarya*, or those of *Mollinedia*. In both the venation varies very much, and it would be impossible to say exactly wherein the difference, if any, lies. I prefer in this case to adopt *Hedycarya*, as the lateral veins form an acute angle with its midrib. The specimen does not resemble any fossil species described and figured, as far as I can make out, but it is not unlike some of the forms of *Hedycarya Cunninghami*, Tulasne.

Daphnandra obliqua, sp. nov.

Plate VI., Fig. 2.

Leaf about 1½ inches long and ½ inch wide, ovate, tapering towards the apex, and with finely crenulate margins slightly oblique. Venation well defined, midrib straight, lateral veins starting at an angle of about 45° from the midrib, and slightly curved, not quite reaching the margin. Tertiary venation is finally reticulate, the veins arranging themselves more or less at right angles to the midrib and to the lateral veins.

The affinities of the leaf which is preserved in specimen No. 248 are not easy to determine. The finely reticulated surface of the leaf strongly resembles the leaves of some *Leguminosæ*, but the crenulate margins preclude the idea of any such relationship. It is, therefore, more probable that it belongs to the order *Monimiaceæ*, and *Daphnandra* would seem a suitable genus to group it under. It is distinct from *Daphnandra Selwyni*, described by me from the Pitfield deposit, not only in the arrangement of the lateral veins, but also in the tertiary venation; but it is not contrary to reason to assume that the two are allied.

PROTEACEÆ.

Lomatia obscura, sp. nov.

Plate V., Figs. 6 and 7.

Leaves 3 inches or more long, ovate, lanceolate, attenuate at base, toothed or serrate above the lower fourth of its length; midrib strongly marked, lateral venation not conspicuous. Smaller veins also immersed in the substance of the leaf, and not preserved. Texture probably thick or coriaceous.

The leaves preserved in specimens Nos. 90 and 113, to which the above description applies, agree so well in general form and character with others undoubtedly proteaceous in type and included in the genus *Lomatia*, that I have thought it well to include these also, although the marked venation generally found in *Lomatia* is absent. The specific name has been given to denote this peculiarity.

Lomatia perspicua, sp. nov.

Plate V., Fig. 1.

Leaf ovate lanceolate, probably 4½ to 5 inches in length and 1 inch wide, toothed or serrate, midrib strongly marked; lateral or secondary veins well marked, slightly curved, and extending to the points of the alternate teeth. Texture probably stout and coriaceous.

The leaf described occurs in specimen No. 103. It appears to be referable to *Lomatia*, although the reticulated veins are not defined. Better preserved specimens may lead to a different conclusion, but the leaf is of too important a type to pass over without mention.

Lomatia reticulata, sp. nov.

Plate IV., Figs. 8, 9; Plate V., Fig. 8.

Leaves lanceolate, 5 or 6 inches in length and 1 inch or more in width, rather regularly toothed, but the teeth more crowded towards the summits. Midrib strongly marked, lateral veins fine but distinct, nearly straight, and reaching the margin at the points of the teeth. The intermediate venation reticulate. Texture firm, but probably not stout.

The leaves from which the above description is drawn are contained in specimens Nos. 83, 106, and 130. The character of the leaves is very nearly that of the existing *Lomatia Fraseri*, R. Br., of the east coast of Australia, but the teeth are closer together and more regular than in that species, and more so than in Ettingshausen's *L. Brownii*, which it also resembles.

Lomatia Bosistooides, sp. nov.

Plate IV., Fig. 10; Plate V., Fig. 9; Plate VII., Fig. 12.

Upper part of leaf only known. Length of leaf probably 5 to 6 inches, width about 1 inch; apex very much tapered; margins strongly toothed, the points of these, however, rounded and directed towards the apex of the leaf. Midrib well marked, lateral veins slightly curved and terminating at the points of the teeth. Tertiary veins reticulate, but arranged so as chiefly to lie at right angles to the secondary veins. Texture rather thin.

The leaves above described are contained in specimens Nos. 256, 263, and 275. They are, unfortunately, fragments only, but the texture and venation are well preserved. They differ from *L. reticulata*, *supra*, in the tapering of the apex, and also in the character of the tertiary venation. The character of the leaves would quite allow of their being placed among the *Saxifrageæ*, as there is nothing in the above description which might not be applied to one or other member of that natural order. The affinities of the leaves in question, however, seem to me to be with Ettingshausen's *Lomatia castaneæfolia* (Contr. Tert. Fl. Aust., Plate XII, Figs. 2 and 3), rightly or wrongly placed by that eminent authority among the *Proteaceæ*, and I have not felt justified in putting the specimens in question under a different natural order, but the above well exemplifies the difficulties of the subject. *L. Bosistooides* differs from *L. castaneæfolia*, Ett., in its more regularly arranged teeth. I have named the species on account of its general resemblance, on a small scale, to the existing *Bosistoa sapindiformis*, F.v.M. (natural order *Rutaceæ*).

Lomatia dubia, sp. nov.

Plate V., Figs. 2, 3, 4, and 5.

Leaves ovate, or ovate lanceolate, attenuate at base, toothed or serrate, 3 to 4 inches in length, midrib strongly marked, lateral veins faintly marked, straight or slightly curved, running out to the points of the teeth; smaller reticulated venation not visible, being apparently immersed in the substance of the leaf. Texture probably thick or coriaceous.

The leaves from which the description is prepared are contained in specimens Nos. 100, 252, 277, and 280. They have affinities with the *Lomatiæ* previously referred to, and much resemble *L. perspicua;* the venation is, however, smoother and less conspicuous. The leaves are not unlike Ettingshausen's *Banksia lancifolia* (Cont. Tert. Fl. Aust., Pl. XII., Fig. 15); in fact, if the leaves in specimens Nos. 277 and 100 were placed together they could easily be considered a stout example of that species. I cannot, however, find any resemblance whatever to existing *Banksiæ*, and consider that they can be much more safely placed under *Lomatia*.

CUPULIFERÆ.

Fagus Muelleri, Ett.?

Plate VII., Fig. 8.

The leaf preserved in specimen No. 253 resembles the figures given by Ettingshausen in his Contribution to the Tertiary Flora of Australia, Plate X., Figs. 3 to 7. The serration of the margins are perhaps somewhat coarser than those of Ettingshausen's leaves, which came from Vegetable Creek, N.S.W., but I do not detect differences of sufficient value to justify my raising the specimen to specific rank.

Fagus, sp. nov.?

Plate VII., Fig. 4.

The leaf fragment contained in specimen No. 479 is very imperfect, and a description of the original leaf would be a risky proceeding. After careful examination I have come to the conclusion that it should be included under *Fagus*. It is a flat smooth leaf, with veins immersed in the lamina, well-defined midrib, and straight lateral veins extending to the margin and terminating at the point of each alternate tooth. The leaf might at first sight be taken for a *Nephelites*, but the texture is that of *Fagus*. The margin is somewhat coarsely serrated. *Fagus Benthami*, Ett. (Cont. Tert. Fl. Aust., Pl. X., Fig. 9), has two additional teeth between each lateral terminal. The only leaf which corresponds in this respect is *Quercus Blamingii*, Ett. (*Ibid.*, Plate IX., Fig. 17), a species which, in my opinion, on account of the character of the serration of the margin, Ettingshausen was not justified in placing under *Quercus*.

Fagus Maideni, sp. nov.

Plate VII., Fig. 10.

Leaf about 1½ inches long, about ½ inch broad, narrow, ovate, oblique at the base, finely serrate, the teeth situate at the termini of the lateral veins. Midrib straight, well-defined, lateral veins straight, or nearly so, extending to the points of the teeth. Leaf smooth and of a delicate texture.

This leaf, which is contained in specimen No. 102, evidently belongs to the *Fagus* group, and I have therefore so included it. At first it seems to resemble *Dryophyllum Howitti*, Ett. (Cont. Tert. Fl. Aust., Pl. X., Fig. 1), but the shape of the leaf-base is quite different, and the serrations in the latter species are double those of the one now described.

Fagus Luehmanni, sp. nov.

Plate VII., Figs. 5, 6, 7, and 9.

Leaf ovate, rhomboidal, oblique at the base, and the two sides of the lamina are equal; margins rather finely serrate, but not sharply so. Midrib straight, lateral or secondary veins straight or slightly curved, extending to the margin and terminating at the teeth. Marginal teeth occur at the end of the lateral veins and also at intermediate points. Leaf smooth, texture probably leathery.

The leaves from which the above description is taken are contained in specimens Nos. 233, 88, 262, and 283; the characters are those of the existing *Fagus Moorei*, F. v. M. There can be little doubt that the genus *Fagus* had many representatives in eastern Australia about the middle of the Cainozoic, and that the foliage of many of the trees was at least as luxuriant and the leaves as large as those of the existing *Fagus Moorei*. Ettingshausen, in his Contribution to the Tertiary Flora of Australia, describes and figures several large-leaved species which he has grouped under *Fagus*. These are in New South Wales, where the climate is warm and more conducive, perhaps, to luxuriant vegetation. There are in the Hobart museum specimens of Cainozoic travertine from Geilston Bay, containing remains of leaves almost identical with the leaves of *Fagus Moorei*, and there can be little doubt of the past wide distribution of large-leaved *Fagi*. What the circumstances were which exterminated these fine-foliaged trees in Victoria and Tasmania, and left *Fagus Cunninghami* and *F. Gunii*, with their tiny leaves only, is a subject for consideration; whether the glacial period which the southern hemisphere underwent was the cause has still to be determined. These conditions would certainly have led to the present poverty of the Tasmanian flora as regards species, and the same results may have been produced from somewhat similar causes in southern and eastern Victoria. The comparative study of the ancient and modern floras of New Zealand seems to show that changes proceeded in those islands on parallel lines.

ORDER ?

Carpolithes Strahanensis, R. M. Johnston ?

Plate VI., Fig. 6.

Specimen No. 141 contains a fossil fruit which appears to me identical with Mr. R. M. Johnston's above-named species.* The affinities of this fruit it seems, at present, impossible to determine, having the exterior only to judge by. If more specimens could be obtained sections might be cut and structure investigated. The form may be the result of the flattening of a fleshy pericarp, or the fruit may be a compressed capsule or siliqua.

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* Johnston, Flora of Tasmania, Pl. XXVI., Fig. 2.

Order ?

Phyllites Gregorii, sp. nov.

Plate VI., Figs. 11 and 12.

Specimens Nos. 268 and 269 contain fragments of leaves which are interesting, as the type apears to be unique. The venation is perfectly clear, but, unfortunately, the outline is not complete, as both base and apex are wanting; it is, however, evidently oblique and lopsided. The leaf seems to have been thin and delicate in texture; the midrib is well marked, so also are the lateral or secondary veins, which are nearly straight, start at an acute angle with the midrib, and reach the margin of the leaf; the tertiary veins are reticulate, but so arranged that they have a general direction at right angles to the secondary veins. The whole leaf, as far as it is preserved, presents a characteristic aspect which should be quite sufficient for identification when more perfect specimens are found.

The affinities of the fossil plant are not at all clear, and I prefer at present to hazard no guess as to them, but it may be worth while to call attention to a certain general resemblance in shape which exists to the leaves of *Agastachys odorata*, R. Br., a Tasmanian proteaceous plant—the venation, however, is not much like, and the texture of the fossil leaf is thinner than that of the living plant referred to.

DESCRIPTION OF PLATES.

Plate III.

Fig. 1. *Tristanites angustifolia*, gen. et. sp. nov. (Spec. No. 77; see also Plate VI., Fig. 7).
Fig. 2. *Tristanites Muelleri*, sp. nov. (Spec. No. 79).
Fig. 3. *Eucalyptus Muelleri*, sp. nov. (Spec. No. 78).
Fig. 4. *Eucalyptus Woollsii*, sp. nov. (Spec. No. 260).
Figs. 5, 6, 7, 8. *Eucalyptus Mitchelli*, Ett. (Specs. Nos. 81, 92, 86, 85).
Fig. 9. *Eucalyptus Woollsii*, sp. nov. (Spec. No. 95).
Fig. 10. *Eucalyptus Howitti*; sp. nov. (Spec. No. 271; see also Plate IV., Fig. 2).

Plate IV.

Fig. 1. *Eucalyptus Houtmanni*, Ett.? (Spec. No. 260).
Fig. 2. *Eucalyptus Howitti*, sp. nov. (Spec. No. 89; see also Plate III., Fig. 10).
Figs. 3, 4. *Eucalyptus Hermani*, sp. nov. (Specs. Nos. 80, 81).
Figs. 5, 6, 7. *Eucalyptus Kitsoni*, sp. nov. (Specs. Nos. 257, 276, 256).
Figs. 8, 9. *Lomatia reticulata*, sp. nov. (Specs. 83, 130; see also Plate V., Fig. 8).
Fig. 10. *Lomatia Bosistooides*, sp. nov. (Spec. No. 275; see also Plate V., Fig. 9, and Plate VII., Fig. 12).

Plate V.

Fig. 1. *Lomatia perspicua*, sp. nov. (Spec. No. 103).
Figs. 2, 3, 4, 5. *Lomatia dubia*, sp. nov. (Specs. Nos. 277, 252, 280, 100).
Figs. 6, 7. *Lomatia obscura*, sp. nov. (Specs. Nos. 90, 113).
Fig. 8. *Lomatia reticulata*, sp. nov. (Spec. No. 106; see also Plate IV., Figs. 8, 9).
Fig. 9. *Lomatia Bosistooides*, sp. nov. (Spec. No. 256; see also Plate IV., Fig. 10, and Plate VII., Fig. 12).
Fig. 10. *Aristotelia*, sp. (Spec. No. 273).
Fig. 11. *Nephelites quercifolia*, sp. nov. (Spec. No. 256).
Fig. 12. *Dammara?* (Spec. No. 82).

PLATE VI.

Fig. 1. *Commerconia ?* sp. (Spec. No. 120).
Fig. 2. *Daphnandra obliqua*, sp. nov. (Spec. No. 248).
Fig. 3. *Hedycarya latifolia*, sp. nov. (Spec. No. 128).
Fig. 4. *Mollinedia prælongipes*, sp. nov. (Spec. No. 270).
Fig. 5. *Mollinedia helicioides*, sp. nov. (Spec. No. 242).
Fig. 6. *Carpolithes Strahanensis*, R. M. Johnston ? (Spec. No. 141).
Fig. 7. *Tristanites angustifolia*, sp. nov. (Spec. No. 115 ; see also Plate III., Fig. 1).
Fig. 8. *Tristanites ?* (Spec. No. 250).
Fig. 9. *Nephelites Berwickense*, sp. nov. (Spec. No. 84).
Fig. 10. *Nephelites ?* (Spec. No. 124).
Figs. 11, 12. *Phyllites Gregoria*, sp. nov. (Specs. Nos. 269, 268).

PLATE VII.

Figs. 1, 2, 3. *Atherosperma Berwickense*, sp. nov. (Specs. Nos. 99, 109, 244).
Fig. 4. *Fagus*, sp. nov.? (Spec. No. 479).
Figs. 5, 6, 7, 9. *Fagus Luehmanni ?*, sp. nov. (Specs. Nos. 233, 88, 262, 283).
Fig. 8. *Fagus Muelleri*, Ett. ? (Spec. No. 253).
Fig. 10. *Fagus Maideni*, sp. nov. (Spec. No. 102).
Fig. 11. *Apocynophyllum Berwickense*, sp. nov. (Spec. No. 110).
Fig. 12. *Lomatia Bosistooides*, sp. nov. (Spec. No. 263 ; see also Plate IV., Fig. 10, and Plate V., Fig. 9).

Hunter's Hill,
Sydney, 23rd December, 1901.

PLATE I

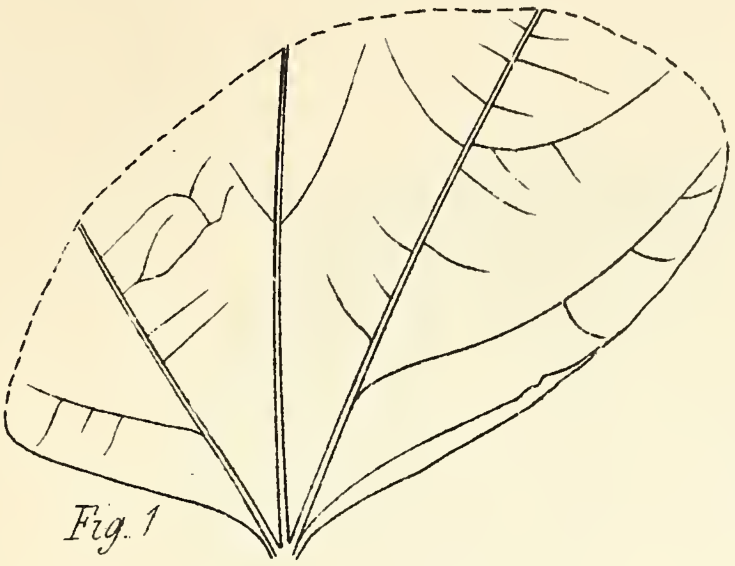


Fig. 1

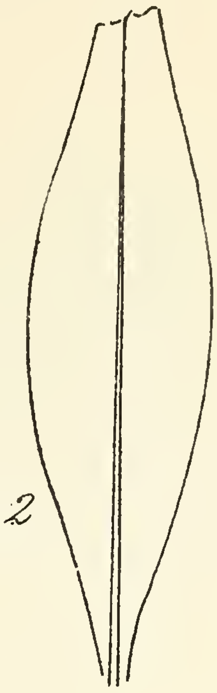


Fig. 2

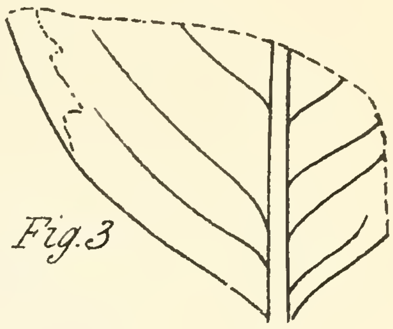
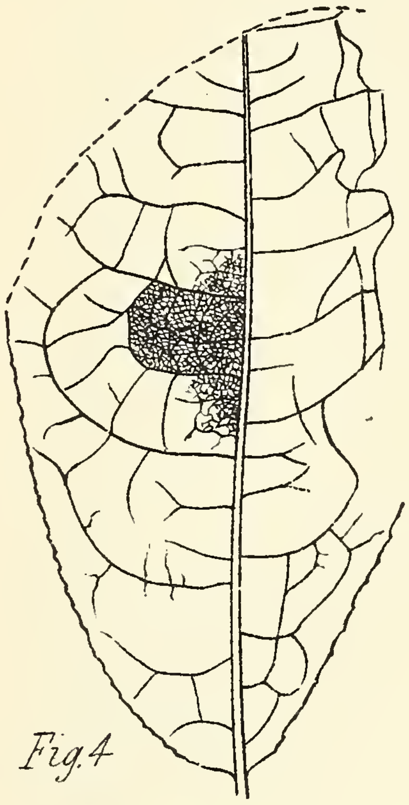


Fig. 3



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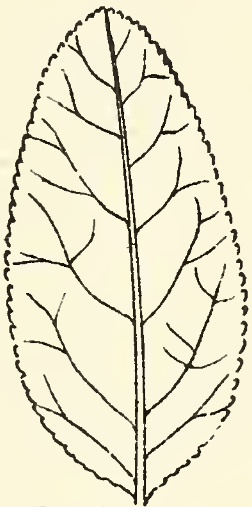

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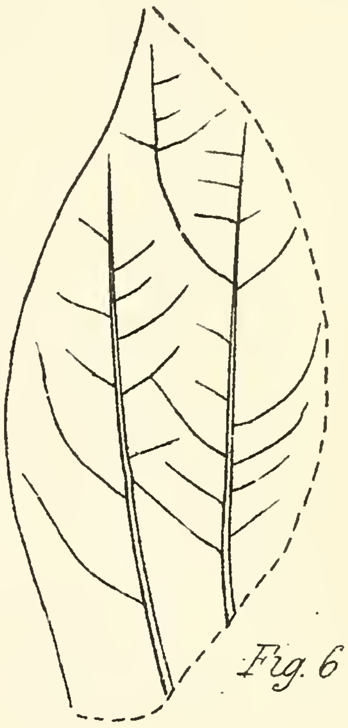

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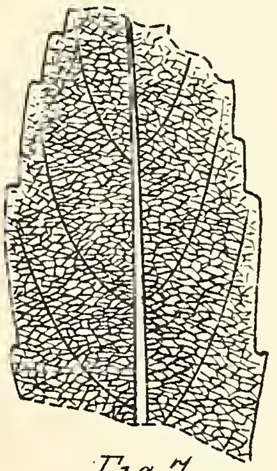

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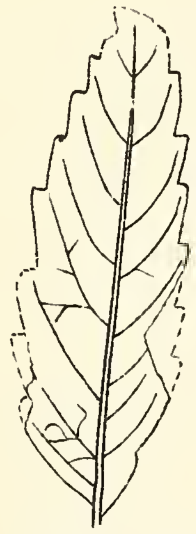

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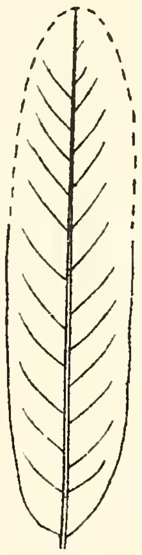

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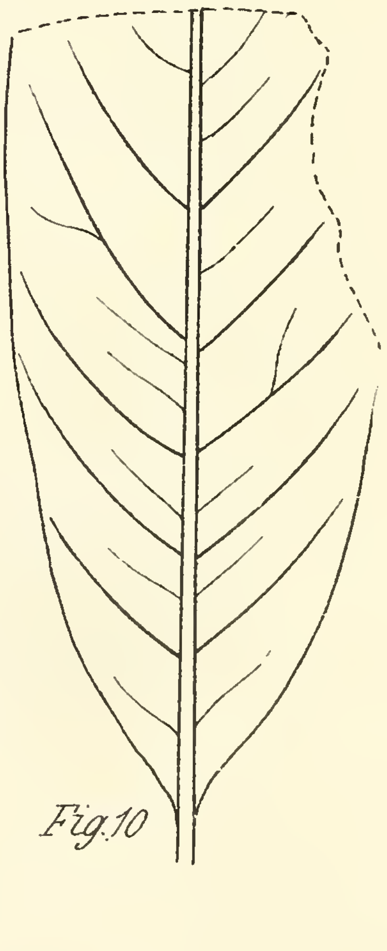

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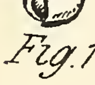

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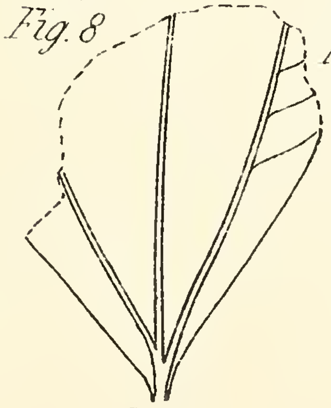

Fig. 12

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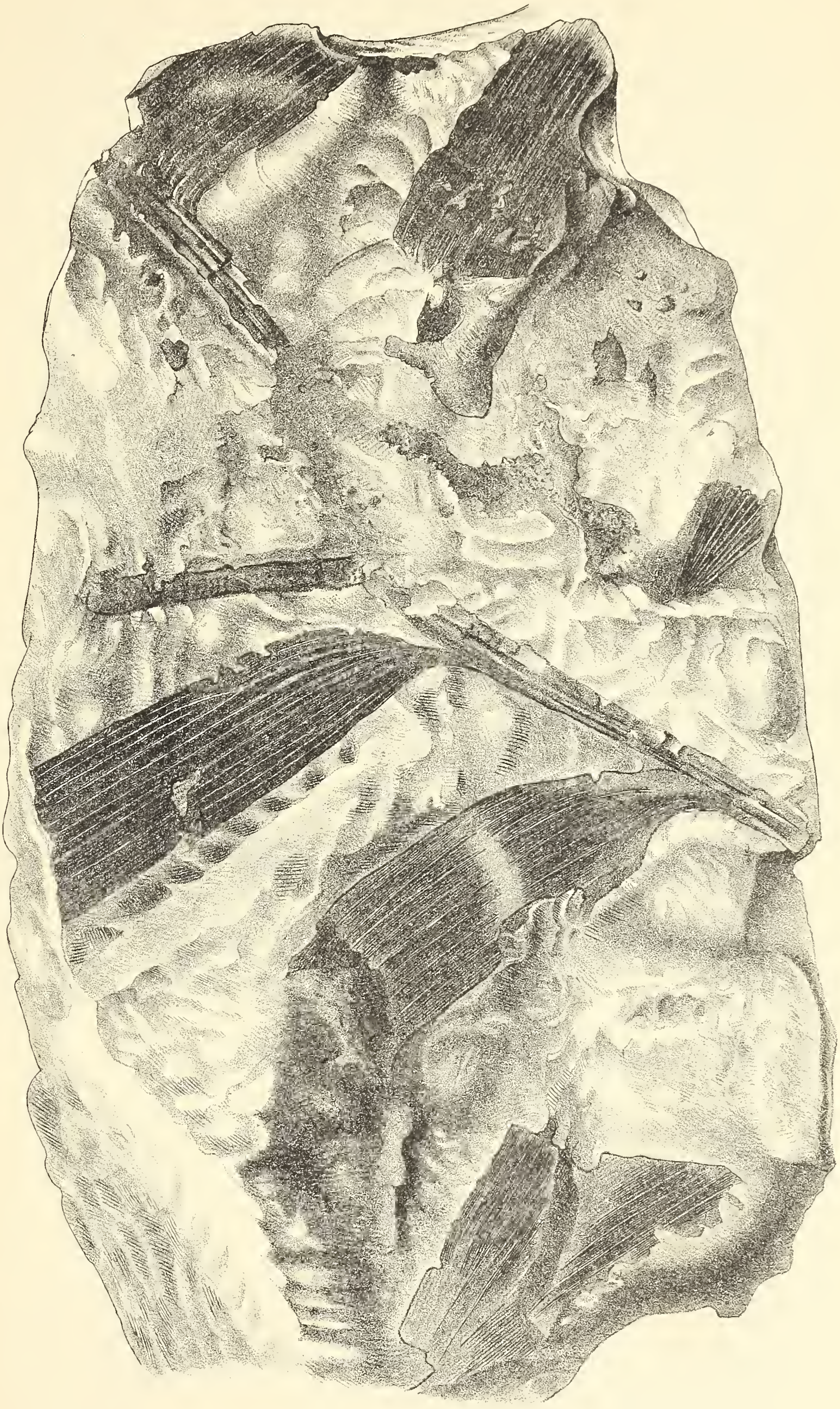
BRITISH MUSEUM
HISTORY



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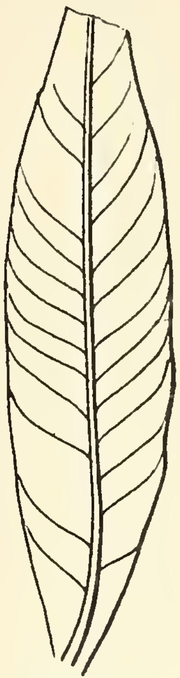
BRITISH MUSEUM NATURAL HISTORY

PLATE III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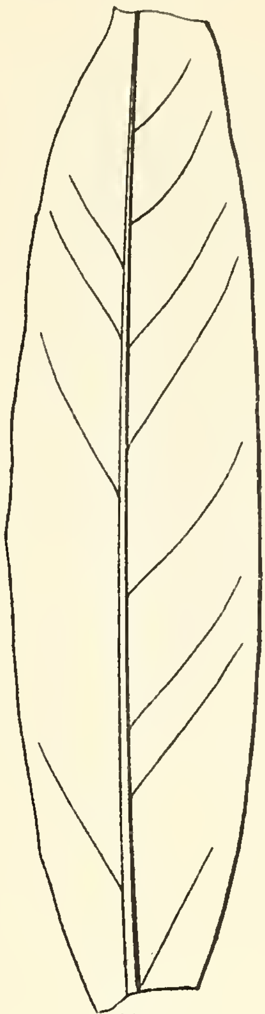
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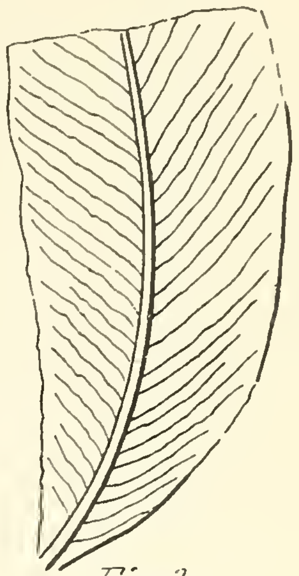
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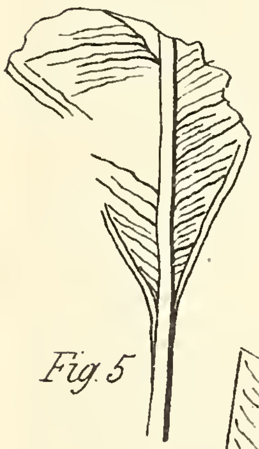
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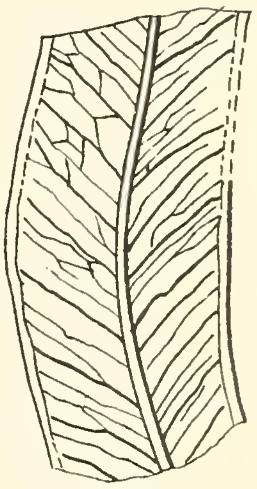
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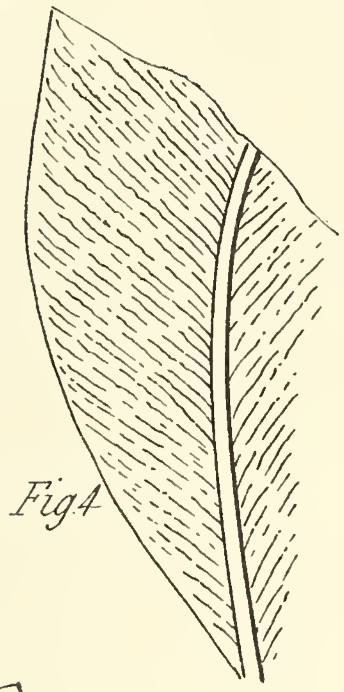
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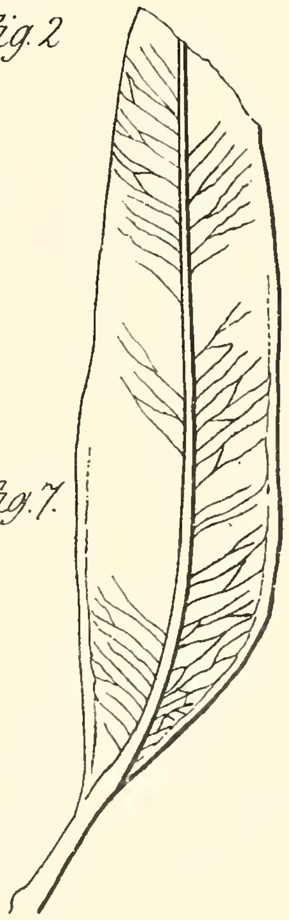
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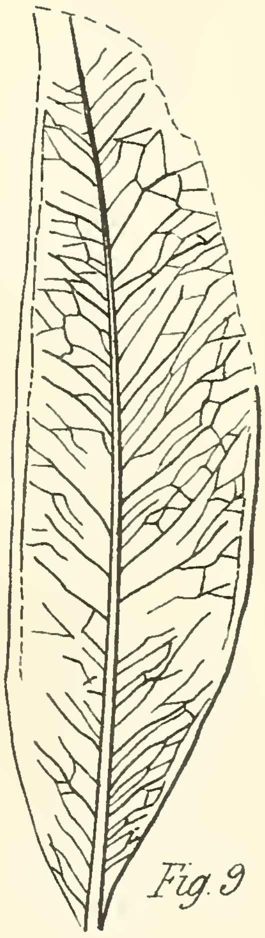
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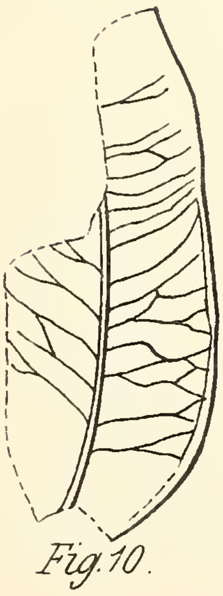
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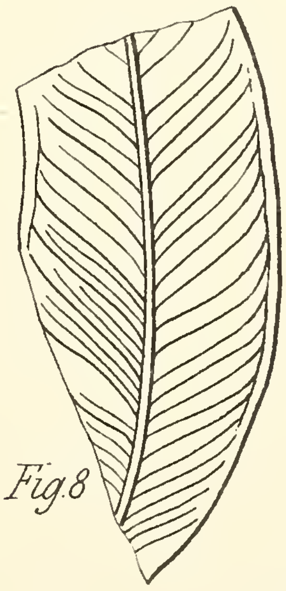
Fig. 8

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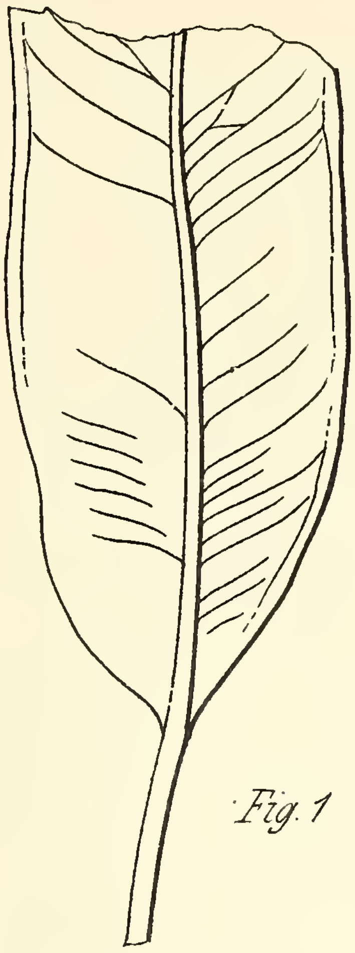
BRITISH MUSEUM NATURAL HISTORY

PLATE IV.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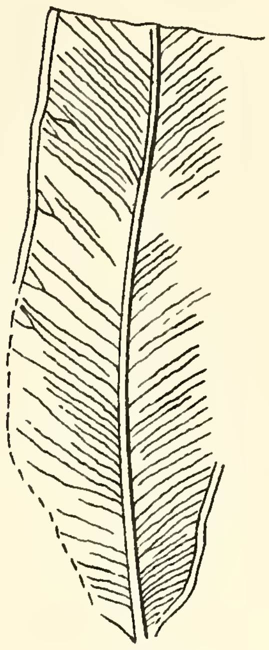
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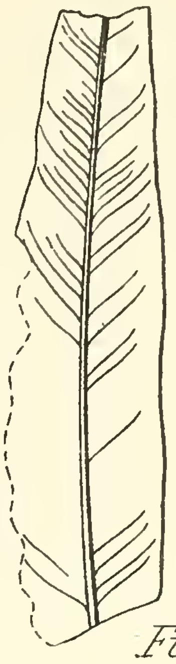
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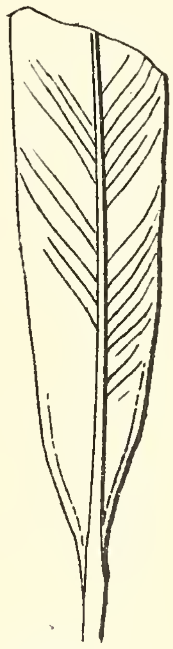
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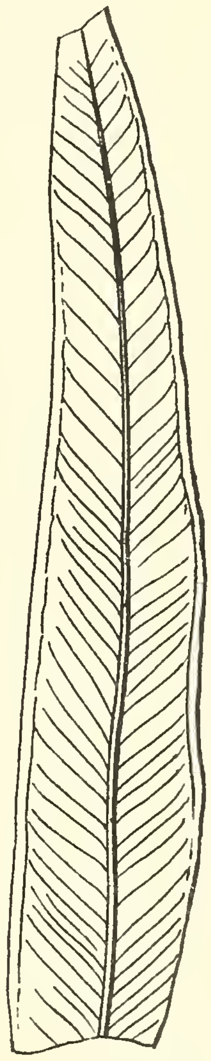
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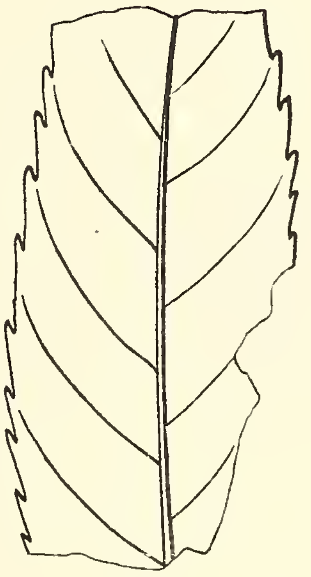
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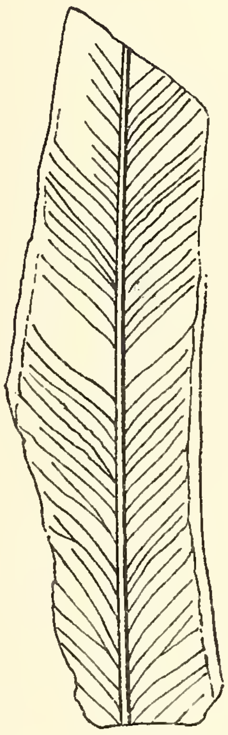
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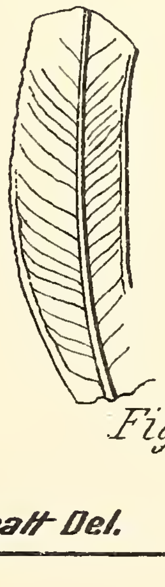
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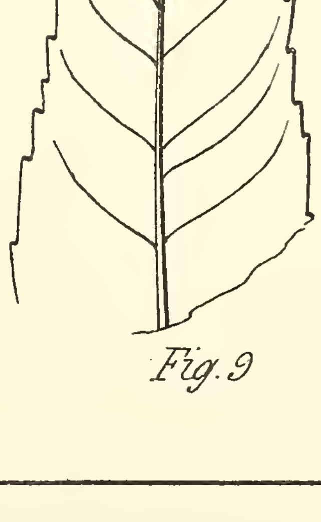
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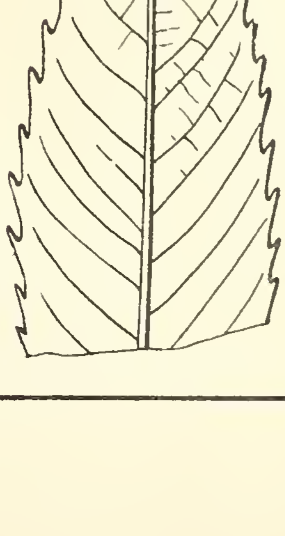
Fig. 10

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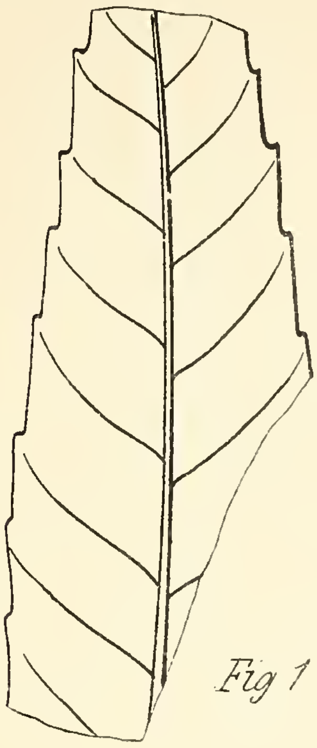
PLATE V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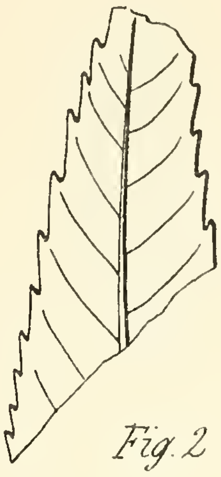
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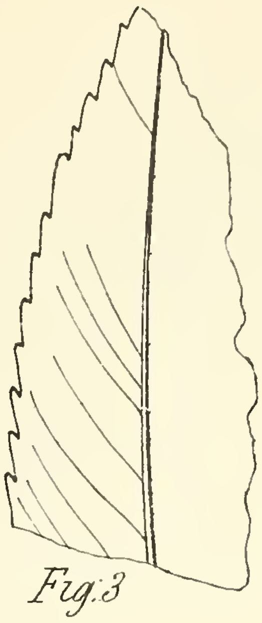
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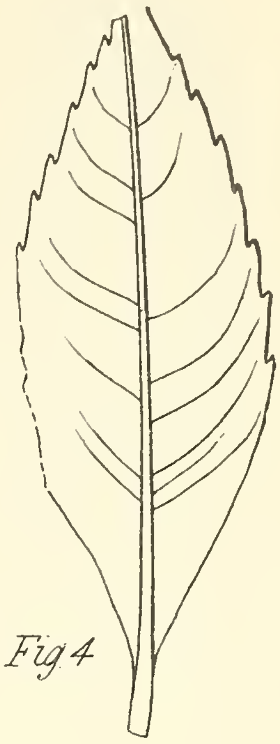
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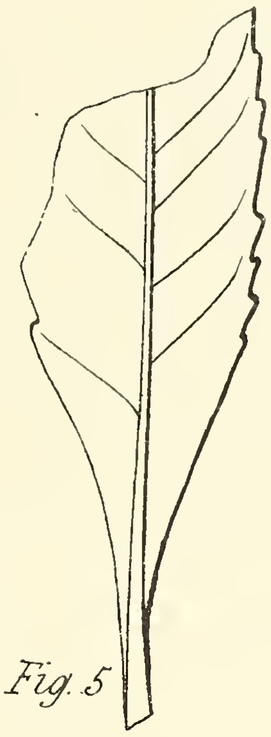
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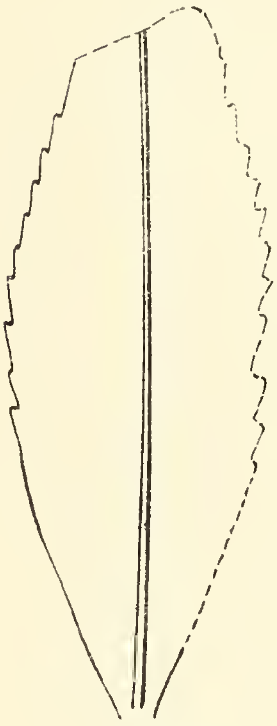
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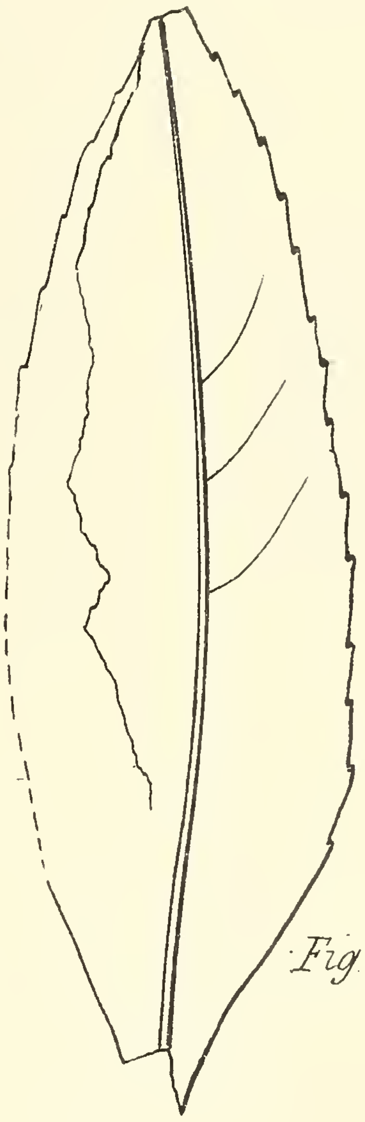
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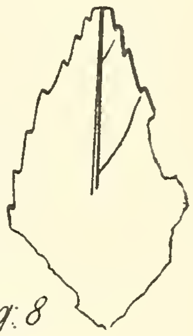
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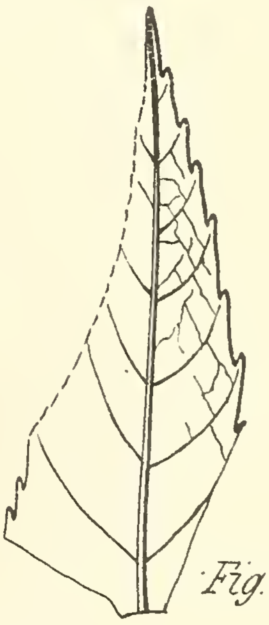
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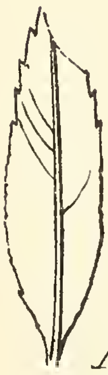
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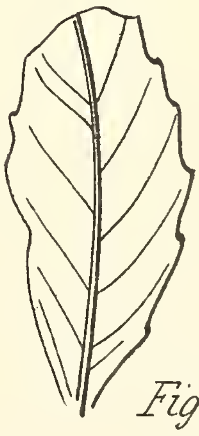
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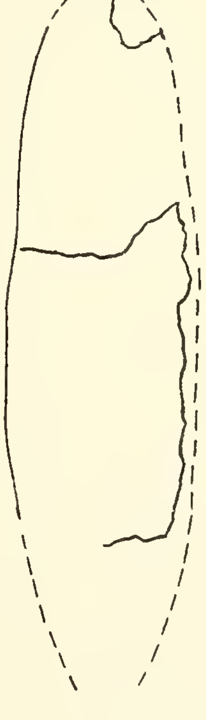
Fig. 12

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PLATE VI

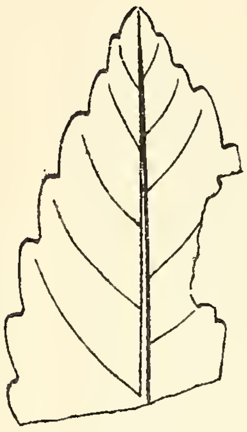
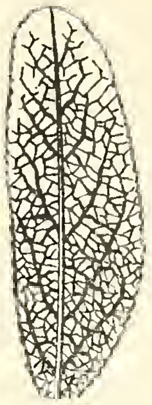


Fig 1



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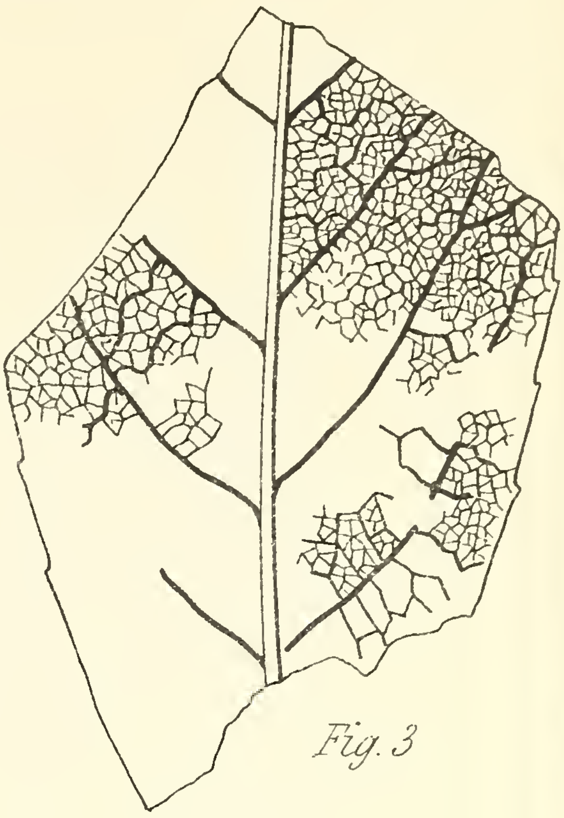

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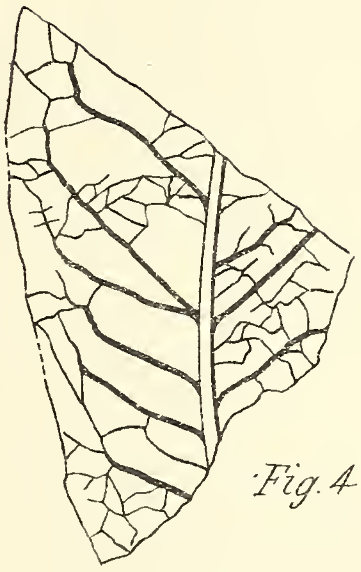

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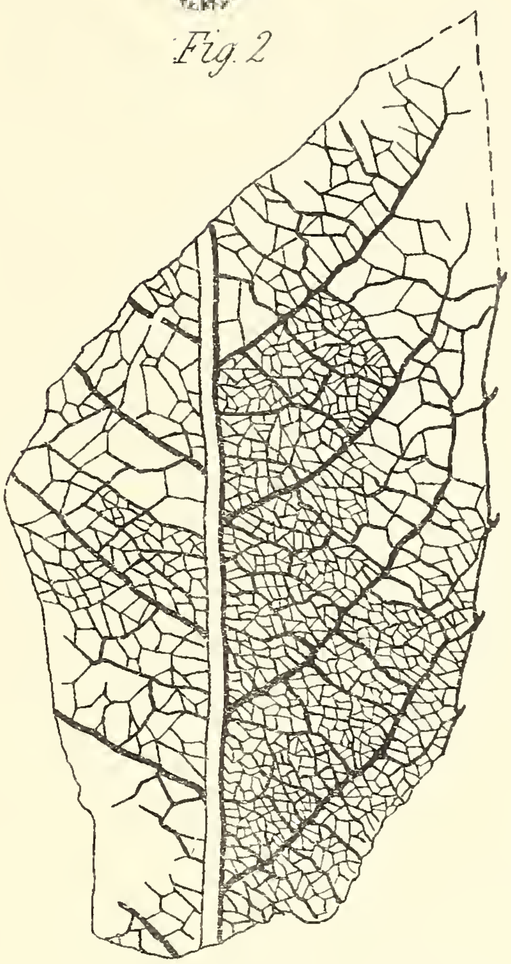

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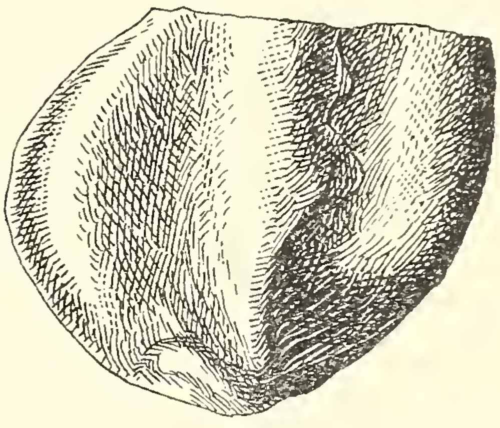

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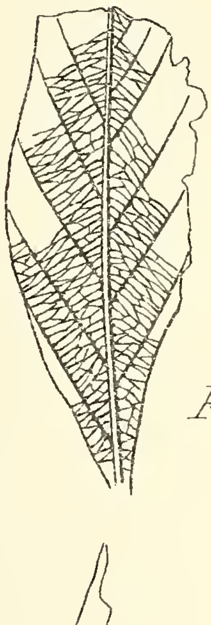

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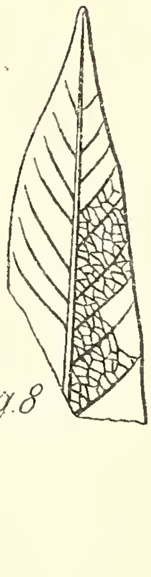

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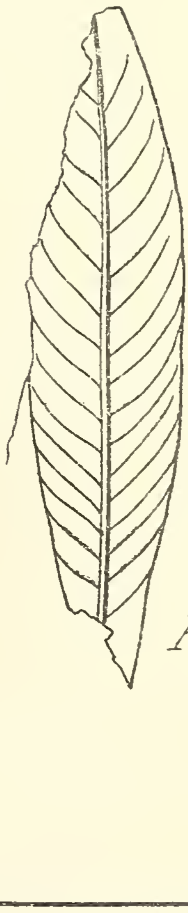

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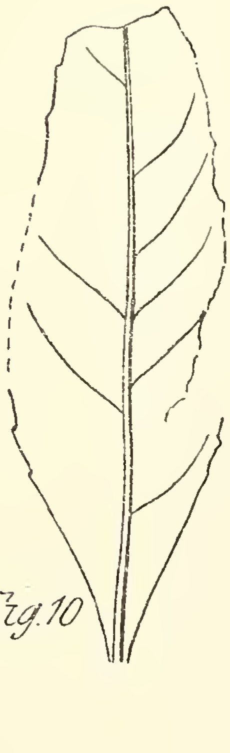

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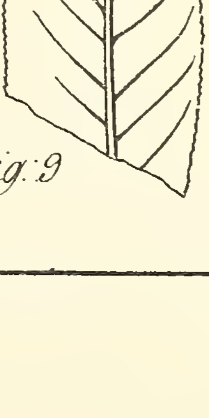

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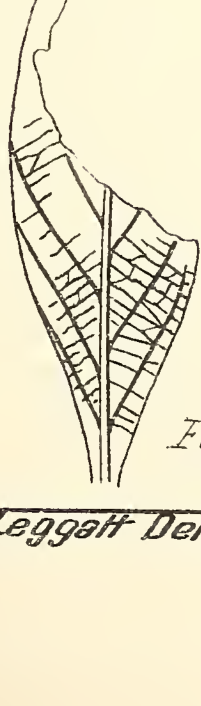

Fig. 12

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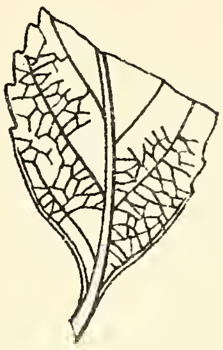
PLATE VII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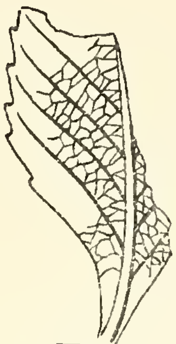
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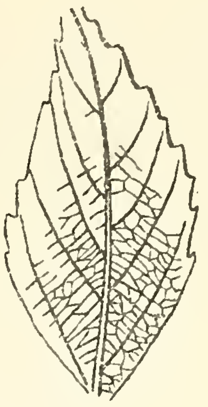
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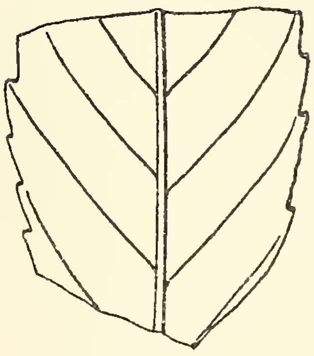
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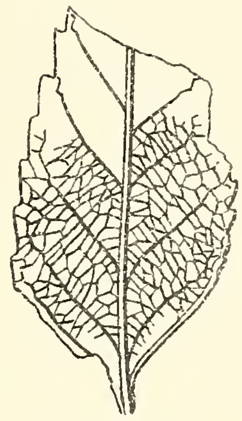
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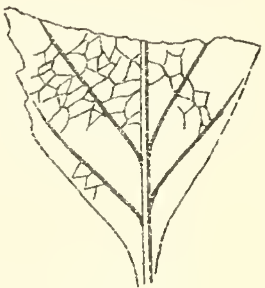
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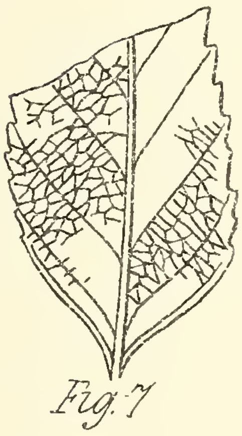
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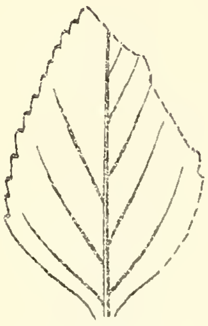
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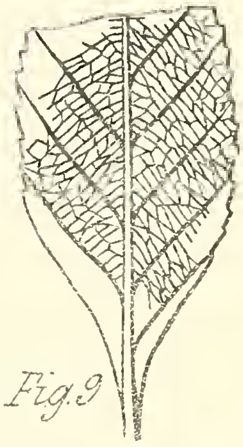
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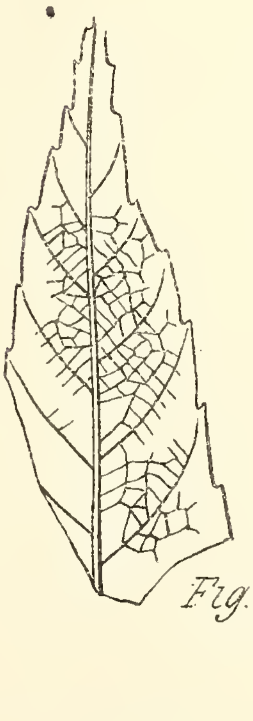
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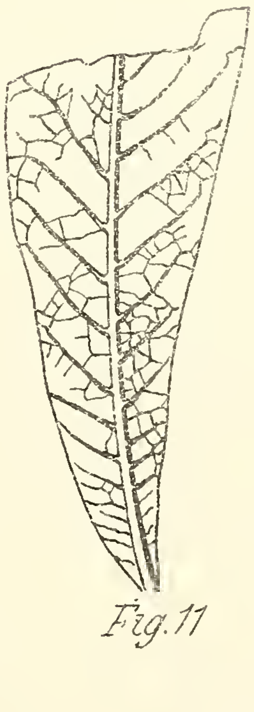
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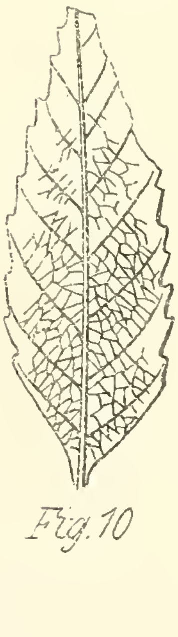
Fig. 10

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BRITISH MUSEUM

6—REPORTS ON GRAPTOLITES.

(*By T. S. Hall, M.A.*)

A Revision of the Species from Eastern Victoria.

As I have at present in my hands for examination the whole of the New South Wales graptolites in the collection of the Geological Survey of that State, I have taken the opportunity of critically comparing the specimens with those from eastern Victoria in the collection of the Department as well as with a few in my own cabinet. Exact comparison of horizons is as yet impossible, owing to the smallness of our collections and the imperfect nature of a good deal of the material, but a few alterations in the lists will be found.

The descriptions of two new species are added, and a table showing the range of the species in Victoria as far as is at present known.

Didymograptus ovatus, n. sp.

Fig. 1.

Hydrosome stout, branches abruptly recurved and gradually approaching one another, so that the polypary resembles, in outline, an imperfect specimen of *Phyllograptus typus*. Branches of a uniform width of 1mm., or to the tip of the mucronate extensions of the thecæ about 2mm. Sicula long and slender with a delicate virgula. Thecæ curved, expanding, about 0·5 mm. wide, overlapping by one-half their length, and at a distance of about 10mm. from the sicula inclined at an angle of 40° ; outer margin curved ; apertural margin deeply concave, and produced so as to make, with the outer margin, a stout, spinose, mucronate extension of about 1mm. in length. Thecæ numbering 12 in 10mm.

The species is closely allied to *D. caduceus*, Salter, but differs in the form of the aperture of the thecæ as well as in the more abrupt reflection of the branches, which maintain a constant rate of curvature instead of becoming almost straight distally, as is the case in Salter's species.

In the specimen figured a minute fault cuts across the earlier formed thecæ, as shown in the figure, so that a correct idea of their form is not possible. The shape of the over-lapped portions of the thecæ can only be made out where shown in the figure, though otherwise the specimen is in a very good state of preservation, the sicula and virgula being very clearly displayed.

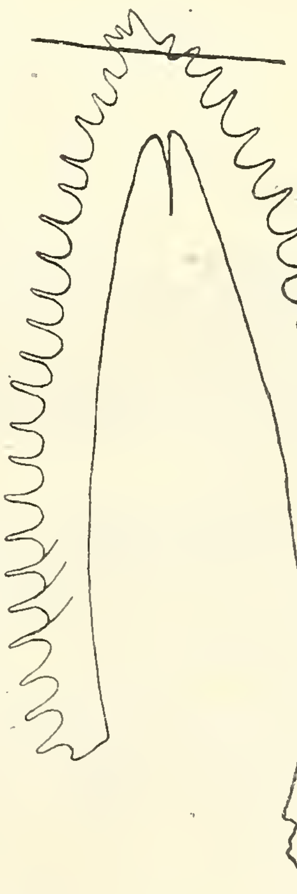

Fig. 1.

Locality and Horizon.—A single specimen from Sandy's Creek, Mitchell River, where *Dicranograptus ramosus* and *Glossograptus hermani* are found in the same beds. Upper Ordovician.

Glossograptus hermani, n. sp.

Fig. 2.

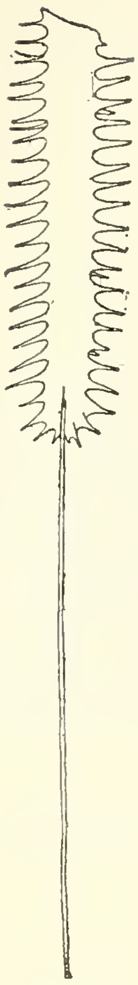

Fig. 2.

Hydrosome broad, narrowing slightly towards the antesicular end. Virgula prolonged, stout, free for about 20mm. Thecæ 11 in 10mm. Apertural spines long, narrow, rigid, sloping slightly upwards from the sicular end; length from inner end of aperture to end of spine about 1·5mm. There appear to be two spines to each theca, but one only is usually displayed. Length of hydrosome more than 20mm.; breadth from inner end of apertures about 2·5mm. near the sicular end, and gradually decreasing to 1·5mm. at the opposite end.

I have previously referred this species, with some hesitation, to *G. hincksii*, Hopk.; from this species, however, it differs in decreasing in width towards the distal end, though agreeing with it in many other particulars. Named as a compliment to Mr. H. Herman.

Locality and Horizon.—Tungamah; Sandy's Creek, Mitchell River; Cravensville; Dark River; Ryan's Creek. Upper Ordovician. The figured specimen is from Sandy's Creek. Coll., Mr. H. Herman.

CORRECTED LIST OF GRAPTOLITES FROM EASTERN VICTORIA.

—	McLaughlan's Creek.	Sandy's Creek, Mitchell River.	Ryan's Creek.	Snowy River, Mt. Deddick.	Accommodation Creek, Deddick.	Cravensville.	Walwa Creek.	Wombat Creek.	Tungamah.	Mt. Deddick (river pebbles)	Cabanandra.	Thoona,
Didymograptus ovatus, n. sp. ...	...	1	...	...	...	...	...	...	...	...	...	...
Pleurograptus sp.	...	...	...	...	...	...	?	...	...	...	...	...
Dicranograptus ramosus, J. Hall...	...	1	...	1	...	...	...	...	1	...	...	...
Dicranograptus sp.	...	...	?	...	1	...	...	...	...	...	...	...
Dicellograptus elegans, Carr ...	...	...	...	...	...	...	...	1	...	...	?	...
D. affinis, T. S. Hall	...	...	...	...	...	...	...	...	...	1	...	...
D. *cf* anceps	?	...	...	...	...	...	...	1	...	...	...	...
D. *cf.* caduceus, Lap.	...	...	...	...	...	...	...	...	1	...	...	...
D. *cf.* morrisii, Hopk.	...	...	...	...	...	...	...	...	...	...	1	...
D. spp.	...	...	...	...	...	1	1	...	1	1	...	...
Diplograptus carnei, T. S. Hall ...	?	...	...	...	...	...	1	?	...	...	...	...
D. foliaceus, Murch.	...	...	...	...	1	1	...	...	...	1	1	?
D. pristis	...	...	...	...	...	...	...	?	?	...	...	...
Climacograptus bicornis, J. Hall...	...	...	...	...	...	1	...	1	...	1	...	...
C. tubuliferus, Lap.	...	...	...	...	...	...	1	1	...	...	?	...
C. tridentatus, Lap.	...	...	...	...	...	?	...	...	...	...	...	...
Glossograptus hermani, n. sp. ...	...	1	1	...	...	1	...	...	1	...	...	?

University, Melbourne, 1st October, 1900.

GRAPTOLITES FROM CASTLEMAINE.

Nos. 132–154.

Specimens Nos. 132–147 are from the railway line between Castlemaine and Chewton, at a point about 5 chains west of the point where the line cuts the township boundary. This is a locality described by myself in a paper on the Geology of Castlemaine, read some years ago before the Royal Society of Victoria. The commonest species among the specimens submitted is *Didymograptus caduceus*, Salter, examples of which occur on every slab. The other recognizable species are *Goniograptus macer*, T. S. Hall, and *Phyllograptus angustifolius*, J. Hall. An indeterminate *Didymograptus* allied to *D. nitidus*, J. Hall, and a *Dendrograptus* also occur, as well as numerous examples of a crustacean, probably *Lingulocaris maccoyi*, R. Eth., Jr.

The horizon of the beds is that which I have called the *Didymograptus caduceus* zone, and is a continuation along the strike from the outcrop on which the zone was practically founded.

The remaining specimens, Nos. 148–154, which were submitted at a later date, are apparently from two or more distinct horizons. Among the identifiable specimens are *Phyllograptus typus*, J. Hall; *Didymograptus caduceus*, Salter; and *Phyllograptus angustifolius*, J. Hall. There is also a *Didymograptus*, which may be *D. extensus*; while crustacea are represented by *Lingulocaris maccoyi*, which has an extended range, and probably by another species of the same genus.

The localities in the district on which more information is required are that to the north of the railway line, in order to determine by the fossils whether the northerly pitch of the strata which I have suggested is really a fact or not, and the country to the west of Castlemaine, especially between the rifle-butts and Maldon. The country near Fentiman's Reef should yield fossils. The existence of the geo-syncline about Muckleford Creek and the repetition of the Chewton rocks at Maldon have not been satisfactorily proved, as they alone can be, on fossil evidence.

University, Melbourne, 19th March, 1901.

GRAPTOLITES NUMBERED 155–160, FROM 1½ MILES S.W. OF KELLY'S HILL, NEAR MATLOCK.

The specimens closely resemble those recorded by myself from the same locality some years ago.*

Dicellograptidæ are represented by a species which is probably *Dicellograptus morrisii*, Hopk. *Diplograptus foliaceus* is also present, and another species of the same genus of a spinose character, and perhaps belonging to the subgenus *Idiograptus* of Lapworth.

The rocks are clearly of Upper Ordovician age, and it will be of interest to decide their relationship to those in the same neighbourhood which contain *Cardium gippslandicum*, McCoy, which that author held to be indicative of (Upper) Silurian age.

University, Melbourne, 14th May, 1901.

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* Proc. Roy. Soc. Vict., N.S., vol. X., 1897, p. 13.

7.—REPORT ON FOSSILIFEROUS IRONSTONE CONGLOMERATE FROM CAPE PATTON.

(*By J. Dennant, F.G.S., F.C.S.*)

This is very interesting material, as it is full of fossils. They are, however, indistinct and generally small—too small, I find, to get good moulds from them. With one exception, I am unable to speak definitely concerning the species present. The following genera, with hints as to species, are suggested as probable:—

Actæon olivellæformis?
Cancellaria? sp. (portion of spire only).
Cassidaria, sp. (probably *aff.* C. wilsoni).
Turritella? sp.
Calliostoma, sp.
Emarginula cymbium?
Dentalium mantelli.
Mytilus? sp.
Barbatia, sp.
Plagiarca cainozoica? (fragment of valve).
Cardita polynema?
Nuculana huttoni?
Nuculana crebricostata?
Magasella? sp.
Bryozoa, spp.
Echinus, sp. (spine).
Flabellum distinctum?
Deltocyathus, sp.

I think there can be little doubt that the strata are of Eocene age—they suggest to me the Cape Otway beds. It is, of course, desirable to examine much more material before a definite statement on the latter point can be made; and I trust that Mr. Victor Stirling, from whom the material reported on was received, will be able to hunt up other specimens before he completes the survey of the locality.

The Eocene deposit at Cape Patton is chiefly interesting on account of its height above sea-level, viz., about 500 feet, while the other sections on this coast from which Cainozoic fossils have been obtained are much less elevated. It may be noted, however, that of the inland Eocene sections the Muddy Creek shell beds are 400 feet, and the Stawell conglomerates more than 600 feet, above sea-level.

8.—ON THE OCCURRENCE OF MIOCENE STRATA AT HORSHAM.

(*By J. Dennant, F.G.S., F.C.S.*)

A few months ago a parcel of fossil shells was handed to me for examination by J. M. Reed, Esq., Surveyor-General. They came from a well on Walmer Estate, near the south-east corner of allotment 2, section B., parish of Vectis East, and about 4 or 5 miles north-west from Horsham. The depth from which the shells were obtained is estimated at from 60 to 100 feet from the surface. Many of them are in good condition and easily identifiable; some, however, are either worn examples, or are represented by fragments only.

The species present are the following :—

Terebra, sp. *aff.* T. additoides (also in Miocene of Muddy Creek).
Bathytoma, n. sp. (probably in Miocene of Gippsland Lakes).
Pleurotoma ? sp.
Cancellaria, n. sp.
Ancilla hebera ?
Eburnopsis ? sp. (fragment).
Fusus, sp. (imperfect examples).
Cominella, sp. (much worn).
Murex, sp. (fragment).
Lampusia, sp. (also in Miocene of Gippsland Lakes).
Trivia, n. sp. (fragment; also in Miocene of Gippsland Lakes).
Turritella pagodula.
Natica subvarians.
Natica subinfundibulum.
Axinæa convexa.
,, laticostata.
,, cainozoica.
Limopsis forskali.
Cucullæa corioensis.
Trigonia howitti.
Cardita pecten, *var.*
Cardita spinulosa (worn).
Dosinia johnstoni.
Chione subroborata.
Corbula ephamilla.
Myadora corrugata.
Myadora, sp. (fragment).
Echinus, sp. (spines).

This list of fossils represents, of course, a Miocene deposit on the same horizon as the Upper Muddy Creek and Gippsland Lakes' beds. Some of the shells are encrusted with the earthy matrix, and from its appearance I judge that the strata are lithologically similar to the well-known Grange Burn and Muddy Creek Miocene.

By the discovery of these shells at Horsham the area of the Miocene in Victoria is considerably extended, the previously recorded deposits of that age being at the Gippsland Lakes, Bairnsdale, Port Phillip Bay, Moorarbool (?) and Leigh rivers, and Muddy Creek.

9.—REPORT ON THE ROCKS OF THE MOUNT WILLIAM GOLD-FIELD.

(*By A. W. Howitt, F.G.S.*)

The following thin slices were submitted to me by Mr. H. Herman, B.C.E., the Acting Government Geologist, with the request that I would furnish some account of them, which I have now much pleasure in doing :—

No. 445	From block 89A, parish of Nekeeya, county Ripon.
,, 446	From block 89C, parish of Nekeeya, county Ripon.
,, 447	From Neild's Creek, immediately north of block 91A, parish of Nekeeya.
,, 448	From block 82, parish of Nekeeya.
,, 449	From block 82, parish of Nekeeya.
,, 450	About one and a half miles west of Greene's Gap, parish of Jalur, county Dundas.
,, 451	About one mile west of Greene's Gap, parish of Jalur, county Dundas.
,, 452	About three-quarters of a mile west of Greene's Gap, parish of Jalur, county Dundas.
,, 453	Wannon Valley, about two miles east of Wannon River, on track from Mount William to Victoria Valley.
,, 454	From Swan's paddock, block 77, parish of Nekeeya, county Ripon.
,, 455	At junction of the Grampian sandstones with diorite, block 82B, parish of Nekeeya, county Ripon.
,, 456	At contact of dyke with the Grampian sandstones, Newton and King's claim, about three-quarters of a mile east of the Wannon River, parish of Nekeeya, county Ripon.
,, 464	Dyke, up to two feet in width, in quartz-mica-diorite.

After examining these slices I found that Nos. 445, 450, and 464 were best adapted for my purpose, as fairly representing the igneous rocks of the collection, and being also less altered by decomposition than the other samples.

Nos. 455 and 456 represent the sedimentary rocks of this series.

No. 445.

This is macroscopically a medium-grained holocrystalline rock, composed of grey to whitish coloured triclinic felspars, with biotite mica and quartz. Occasional felspar phenocrysts are evident.

The thin slice shows that in addition to the above-mentioned minerals there are also magnetite and hornblende.

The biotite is in ragged-ended crystals which, where least altered, are pleochroic in shades of dark-brown to brownish-yellow. As is commonly the case in rocks of this character, the mica has been more or less bleached, and in places converted into a green chlorite. In certain instances this is in concentric radial forms, the component fibres of which are optically negative.

The hornblende is in smaller amount than the mica. It is pleochroic, $\mathfrak{a}$ = yellow, $\mathfrak{b}$ = bright green, $\mathfrak{c}$ = dark dull green.

The alteration of the hornblende is to chlorite and epidote. The triclinic felspars are the predominant feature in this rock, and are twinned according to the albite and, secondarily, according to the Carlsbad law.

One felspar, of relatively well-defined outline, included a later generation of a dark-green hornblende.

All these felspars are more or less kaolinized.

The measurements made of the extinction angles in this slice are given in the following table. Before discussing them, I must note here that the thin slices numbered 446, 447, 448, 451, 452, 453 are all of the same general character, but are mostly more altered or more decomposed than No. 445. They need no further special mention, unless to say that they are quartz-mica-diorites.

TABLE OF EXTINCTION ANGLES.

No. of Slice.	P (001)	Zone P K (001) (100)	Zone P M (001) (010)	M (010)
445	1° 10′	15° 0′	...	+6° 16′
446	2° 45′	...	...	7° 5′
447	0° 0′	16° 22′	...	6° 32′
448	0° 0′	12′ 24′	...	7° 15′
449	0° 0′	10° 39′	...	...
450*	0° 32′	...	...	7° 5′
453	0° 0′	...	...	...
454	..	20° 59′	...	...
455	1° 0′	...	...	...

* Granophyric quartz-diorite.

In the above are given the minima on P and the maxima on the other planes. In No. 445 I was enabled to determine on a well-marked section, near to M (010), that the sign was positive, and therefore that the felspar belonged to the oligoclase group.

The general similarity of the readings in each series shows that the plagioclase in all the samples belongs to the same group; and, as I have already said, one at least is oligoclase.

According to Dr. Hintze* the composition of oligoclase is from Ab6 An1 to Ab3 An1; and of andesine from Ab3 An1 to Ab1 An1; and he quotes the more recent statements of Schuster that in oligoclase the extinction angle on P (001) is from + 1° 04′ to 2° 45′, and on M (010) from + 4° 36′ to + 11° 59′. On andesine he states it to be from − 0° 35′ to − 5° 10′ on P (001).

According to Lévy and La Croix† the maximum extinction is in the plane perpendicular to M, or, as I read the observation, in the zone P K, + 12° for oligoclase and + 21° for andesine.

The above table shows that these felspars form a group which lies between oligoclase and andesine, covering the last of the former and the first of the latter.

It seemed desirable to obtain some further data to control, if possible, the optical results of my examination of the felspars of these rocks, as exhibited in the thin slices. Mr. Henry C. Jenkins, the Government

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* C. Hintze, Handbuch der Mineralogie, Leipzig, 1897, pp. 1474, 1496.

† Les Minéraux des Roches, 1888, pp. 205, 207.

Metallurgist, was so good as to make a quantitative analysis, not only of the felspars of the specimen No. 445, but also of the rock itself. The latter is given in analysis No. I., and the former in analysis No. II., below.

No. I.

Silica	66·86
Alumina	14·91
Ferric oxide	4·06
Ferrous oxide	3·65
Manganese oxide	trace
Lime	3·25
Magnesia	1·28
Soda	4·22
Potash	1·49
Water at 100°	0·09
〃 combined	0·58
	100·39 %

No. II.

Silica	67·80
Alumina	20·76
Lime	3·77
Magnesia	trace
Potash	trace
Soda	7·94
	100·27°/₀

Sp. gr., 2·62.

Analysis No. II., when calculated out in the form of a lime felspar and a soda felspar, had a surplus of silica which may reasonably be considered as representing free quartz, attached to or entangled in the felspar. Disregarding this, and recalculating the other constituents to 100, and again casting as lime and soda felspars, the result was Ab5 An2. The specific gravity of the felspar was found to be 2·62, but as this felspar is seen under the microscope to be all more or less kaolinized the specific gravity is lower than it would be from an unaltered felspar. Further, the kaolinization would result in a loss of lime and soda, alumina and silica, thus disturbing the relative proportions of the felspar constituents, but in what degree there is no means of judging.

Allowing for all this, the constitution of the felspar might be Ab3 An1, which would agree with the optical results. As it stands the felspar would be placed in the andesine group, but the observation that the extinction in M was + 6° 16′ shows that in that instance the felspar is oligoclase. The felspar extracted for analysis and the thin slice were both taken from the same specimen of rock.

No. 450.

This is a good example of granophyric structure. The rock is composed of pseudo-spherulites which, as is usual in such rock structure, consist of a central crystal enveloped by micro-pegmatite. In this slice the central crystal is either quartz or felspar, and the micro-pegmatite consists of felspar and quartz, intergrown in arborescent or fern-shaped forms. These structures may be pictured as simultaneous intergrowths of a crystal of felspar and a crystal of quartz, the component parts of each portion obscuring at the same time. If the central crystal is felspar then the surrounding pegmatitic extensions of felspar are oriented in accordance with it. So also, when the centre is quartz, are the extensions of quartz in optical accord with it.

The conditions under which the rock had crystallized made it difficult to obtain satisfactory readings of extinction angles, but those obtained are given in the preceding table, being 0° 32′ on P and 7° 5′ on M.

No. 464.

The composition of this rock is as follows :—

(1) A ground mass consisting of a considerable amount of iron ore, apparently magnetite ; (2) very numerous, somewhat stout, but very minute prisms of almost colourless crystals of augite in which the extinction angle, $c' : \mathfrak{c}$, was as high as 50° 12′. Although faintly flesh-coloured they are not sensibly pleochroic ; (3) contemporaneous with this augite are crystals of biotite, large in size compared with the augite, and strongly pleochroic in shades of dark brown to almost complete absorption of the ray ; (4) the latest generation is of small, but comparatively stout, lath-shaped felspars, in some cases not showing any twin structure. The only extinction measurement I could obtain was 9° 39′ and 9° 41′ on either side of the twin plane.

In the ground mass are scarce phenocrysts of relatively large size. They are colourless, showing a well-marked prismatic cleavage, and with an obscuration angle in one case of $c' : \mathfrak{c}$ of 34° 5′. The central part is surrounded by the same mineral in which the cleavage is approximately perpendicular to the surface of the interior crystal. This appears to be one of the iron-free monoclinic pyroxenes.

This rock may be described as an augite-bearing diorite-porphyrite.

The above series of holocrystalline igneous rocks consists of several slightly different forms of quartz-diorite.

No. 455.

This slice is composed of clastic grains of quartz, closely compacted together with very little cementing material, which in part is muscovite.

No. 456.

This also is a very quartzose rock, consisting of numerous clastic grains of quartz set in a mass of still finer quartzose material, the finer cementing material being muscovite in small amounts.

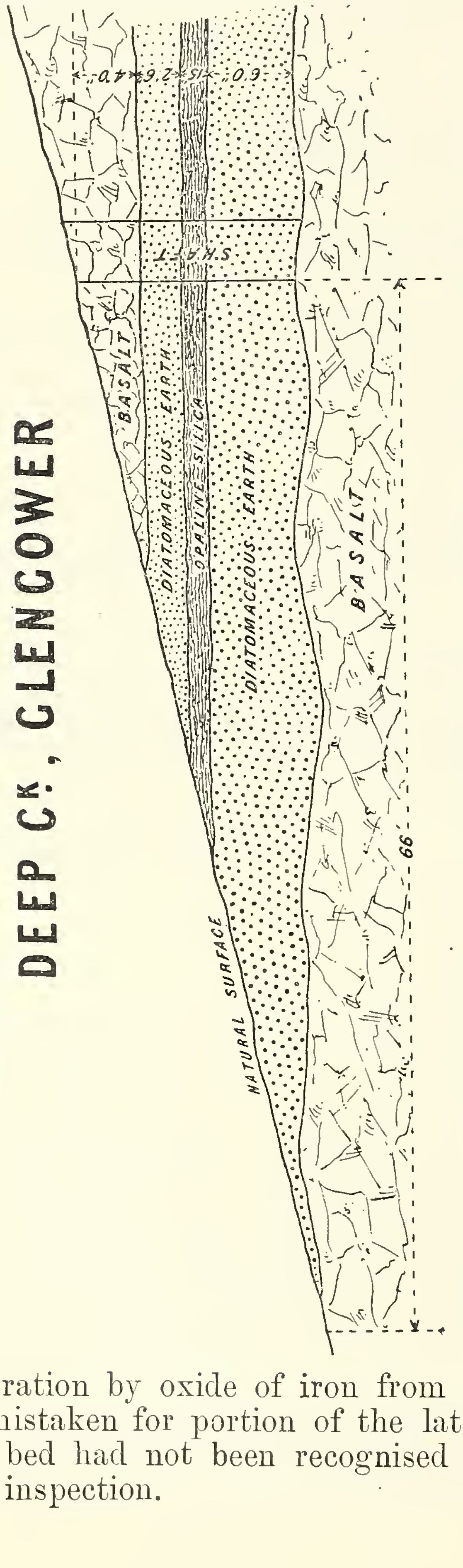
These rocks may be described as quartzites which have undergone metamorphism.

12th March, 1901.

10. NOTES ON A DEPOSIT OF DIATOMACEOUS EARTH AT DEEP CREEK, GLENGOWER.

(By H. Herman, B.C.E., F.G.S.)

I have the honour to submit the following notes on a deposit of diatomaceous earth at Glengower, inspected by me in accordance with instructions on 3rd March, 1900.


SKETCH SECTION
Showing Occurrence of Diatomaceous Earth
DEEP CK., GLENGOWER

The exact locality is on the east bank of Caralulup or Deep Creek, in block D_2, parish Glengower, county Talbot, and is included in quarter sheet No. 57, N.E., upon which, however, the deposit under notice, having been only recently discovered while making an excavation for a road, is not marked.

The diatomaceous earth, in the only clear section (see accompanying sketch, margin) exposed at the time of my visit, is seen as two distinct beds, separated by a band of common opal, all of which in turn are enclosed between layers of basalt. The lower bed, which only has been worked up to the present, is white in colour, with occasional stains due to oxide of iron, and the upper is light-grey, while both are easily pulverulent. The former has been driven on for a distance of about 90′ from its outcrop on the side of the hill, and short drives in various directions show the bottom to be rather uneven, the roof (the band of opal) very even, and the thickness of the earth to vary from 2′ to 7′, with an average of about 4′. A shaft sunk about a chain S.E. of these workings passed, according to Mr. D. Irvine (the owner of the deposit, and the land on which it is situated), through 17′ of decomposed basalt, 1′ 6″ of opal, and 7′ of pure earth, the latter resting on vesicular basalt. If this be correct the upper bed of earth must thin out very quickly from its outcrop, but it is quite possible that, owing to discoloration by oxide of iron from the decomposed basalt above, it has been mistaken for portion of the latter, especially as the existence of an upper bed had not been recognised even in the principal workings prior to my inspection.

Several chains to the north indications may be seen of the continuation of the deposit, while about six chains in the opposite direction its southerly continuation is disclosed in a small excavation, not large enough, however, to furnish reliable data as to thickness or quality, or the existence of two beds.

The area of the deposit is quite possibly extensive, and could be ascertained by a number of hand bores at a small cost.

Up to the time of my visit 200 or 300 tons of earth had been taken out, of which 150 tons, Mr. Irvine informed me, were sold by him at 35s. per ton (not including bags), delivered undried at Clunes railway station, 10 miles distant. He is prepared to supply any quantity at £2 2s. 6d. per ton, dried. Mr. Irvine also informed me that when first mined about nine and a half wheat bags of earth weighed a ton, but after drying well in the sun fifteen bags were required to make up the same weight. According to this statement the water lost by drying one ton of wet earth is equal in weight to five and a half bags of dry earth, or $\frac{11}{30}$ of a ton, or about 37 per cent. of total weight.

Three samples, A, B, C, from the lower bed, all selected by myself, on analysis at the Mines Department laboratory gave results as hereunder. A was taken at random from a large sun-dried stack in Mr. Irvine's store-room, and B and C from portions of the bed presenting respectively a favorable and unfavorable appearance for purity :—

	A (No. 79).	B (No. 80).	C (No. 81).
SiO_2	85·58	85·59	81·31
Al_2O_3 Fe_2O_3	7·52	8·33	6·40
CaO	·80	·79	4·73
MgO	1·21	1·18	1·19
Ignition loss at red heat ...	4·63	3·68	6·14
	99·74	99·57	99·77

Samples D and E, of the opaline silica and the upper bed respectively, also selected by myself, after drying at 108° C. gave—

	D (No. 175).	E (No. 176).
SiO_2	87·47	81·57
Al_2O_3	2·35	nil
Fe_2O_3	5·06	11·30
CaO	trace	trace
MgO	0·24	1·74
MnO	trace	—
Ignition loss at red heat ...	4·56	4·92
	99·68	99·53

Note.—The numbers in brackets are the laboratory record numbers.

Neglecting water and volatile matter, the percentages of silica for A, B, C, D, and E are, respectively, 89·98, 89·31, 86·84, 91·95, and 86·22.

The Lillicur earth, the principal deposit in Victoria, contains, according to Mr. F. M. Krausé,* about 6 per cent. of alumina and lime, and the complete analysis given hereunder shows that its quality is not greatly different from that of the Glengower deposit. The latter, like the Lillicur, is easily pulverized between the fingers to an impalpable powder, and in analysis compares favorably with similar deposits in other parts of the world.*

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* Krausé, The Tripolite Deposits of Lillicur. Trans. R. Soc. Victoria, Vol. XXIII., 1887, p. 251.

Analyses of other Victorian deposits have given the following results :—

—			Cardigan.	Talbot.	Lillicur.
Silica	per cent.	... ...	79·89	87·98	83·88
Alumina	,,	... ...	9·95	1·15	7·41
Iron Oxide	,,	... ...	trace	—	—
Lime	,,	... ...	trace	1·06	1·24
Magnesia	,,	... ...	trace	0·38	0·75
Water	,,	... At 100° ...	5·41	9·38	6·23
		... After ignition	4·78	...	...
			100·03	99·95	99·51

Neglecting water, the percentages of silica are 88·85, 97·09, and 89·48, respectively.

The Cardigan and Talbot analyses, kindly furnished by Mr. R. H. Walcott, of the Technological Museum, are by Messrs. T. S. Hart and F. M. Krausé respectively. The Lillicur analysis, by the late Mr. Cosmo Newbery, is taken from the Mineral Statistics of the Victorian Mines Department for 1885. The Cardigan sample was from a diamond-drill bore, 600 feet from the surface, was rather hard, and rendered impure by clayey and carbonaceous matter.

The association of common opal and various forms of siliceous sinter with diatomaceous earth is quite common in hot-spring districts, active and extinct. In the form of veins in the earth, opal has been noted at Lillicur in Victoria,† Cooma and Wyrallah in New South Wales,‡ and very likely other Australian localities. At Glengower the deposit is a well-defined stratification 15 to 18 inches thick, and is probably a precipitate from a hot spring—a phase of the intermittent volcanic activity of the period—aided, possibly, by the secretionary action of the diatoms themselves.§

Many similar, but as yet undiscovered, deposits probably exist beneath the basaltic plains of the Glengower district.

Office of Mines,
Melbourne, 9th July, 1900.

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* Card, G. W. and Dun, W. S., The Diatomaceous Earth Deposits of New South Wales, Records Geo. Surv. N. S. Wales, Vol. V., Part III., 1897, p. 128.

† Krausé, *op. cit.*

‡ Card and Dun, *op. cit.*

§ W. H. Weed, Formation of Hot Spring Deposits, 9th Ann. Rep. U.S. Geol. Survey, p. 619 *et. seq.*

11.—REPORT ON LIGNITE AT WONWRON.

(*By A. E. Kitson, F.G.S.*)

The deposit of lignite at Wonwron, about 9 miles north from Yarram, and 16 miles from Port Albert, occurs in Middle Creek, a stream joining Mac's Creek, on the borders of the Trenton Valley morass, through which the combined streams flow along an artificial channel into the Tarra River, near the bridge on the Yarram road. Since the various drains in existence have been excavated, the place cannot correctly be called a morass, so far at least as the portion noticed, the western, is concerned.

The lignite outcrops for a distance of only about 30 feet in the bed of the creek in allotment 77, parish of Wonwron. Attention was first drawn to the occurrence in 1875, by Mr. R. A. F. Murray, F.G.S., who states*—"A siliceous conglomerate exposed in Middle Creek appears to pass under the lignite lower down the creek."

A short preliminary report was also made later on by Mr. Jas. Stirling, who says†—"The brown coal is exposed by several shafts in the bed of Wonwron Creek, and by small excavations along the eastern bank. I was unable to determine the thickness of the deposits, as none of the shafts appears to have passed through the beds, although sunk to a depth of 30 feet in the coal."

At the present time there is even less of the deposit visible, as over an extent of only a few square yards can it now be seen; though formerly, according to Mr. W. Morris, owner of the allotment, it could be observed here and there in the stream for some distance higher up. The only shaft now noticeable on the creek flat was nearly full of water at the time of my visit. Lignite could, however, be seen in it about 4 feet from the surface. This material as observed is really more of a brown coal than a lignite, as the woody texture is not generally noticeable.

The locality is an interesting one, inasmuch as in an area of about a square mile are found Jurassic sandstones; lignite, leaf-beds, volcanic clays and basalt of probably Eocene age; ferruginous clays and grits, sands and gravels of perhaps Miocene age; and, lastly, Post Pliocene fluviatile deposits of pebbly gravels, sands and alluvium.

The lignite appears to dip about S. 70° E. at about 10°. Ascending the creek from its outcrop nothing was visible except the fluviatile deposits till reaching about the western boundary of allotment 77, where a small outcrop of light-coloured plastic clay was noticeable. From here to a point about 3 chains above the junction of a small creek coming from the north-east nothing but recent drift was observed. At this place is a small series containing leaf-bearing clays, as shown in the accompanying section. The deposits show current bedding to a large extent. At creek level a bed of unknown thickness of white plastic clay occurs, overlying which are yellowish-white finely sandy and micaceous leaf-bearing clays, 1 foot; whitish gravelly and sandy current-bedded grits, 3 to 6 feet. Post Pliocene fluviatile deposits, principally made up of large pebbles of basalt scattered through sandy and gravelly alluvium, overlie these beds, which dip S. 30° E. at about 25°. The general direction of the dip is probably as shown by the section, but the amount cannot be relied upon as that of the beds generally, owing to the current-bedded nature of the deposit. The leaf-bearing clays contain considerable quantities of fine, platy sand and white muscovite, the two minerals resembling each other so much that it is difficult to distinguish between them without the aid of a pocket lens. The beds have a distinct resemblance to certain ones in Grice's Creek, Mornington, recently described* by me.

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* Murray, Report on the Geology and Mineral Resources of South-Western Gippsland. Prog. Rept. Geol. Surv. Vict., No. III., 1876, p. 148.

† Stirling, Preliminary Report on Brown Coal Deposit at Wonwron. Report on the Victorian Coal-fields, No. 1, p. 14. Special Report, Dept. of Mines, Vic., 1892.

The leaves, principally impressions, appear to be similar to those at Berwick and elsewhere, and they have been examined by Mr. Hy. Deane, M.A., F.L.S., of Sydney.† Among the creek gravels, between the leaf-bed and the lignite, a few pebbles of indurated dark siliceous slates, hard siliceous sandstones, and the characteristic quartz of the Jurassic pebbles occur. They resemble those commonly found in the lenticular patches of conglomerates so frequent in the Jurassic series, and have probably been here secondarily derived from the leaf-bearing series, and not directly from the Jurassic beds.

In following the creek a little further up, bluish-grey clays, covered with rusty specks and drab splashes, come into evidence, and a few yards still further up a bed of brown clay splashed with drab and grey brownish-yellow patches. These clays may also be seen in the bed and banks of the little tributary from the north-east joining Middle Creek near the leaf-bed. They appear to be volcanic clays, and either thoroughly decomposed basalt or volcanic ash. Overlying them is dense, hard, dark basalt containing visible olivine, such as occurs up the steep slope in allotment 78 and in the south-eastern corner of the allotment joining it on the west. It also apparently runs down the eastern side of Middle Creek for some distance, forming a raised flat 5 to 7 chains wide. These clays appear here and there in the bed of the stream for a good many chains above its junction with Middle Creek.

Mr. Murray states‡ that hard, undecomposed, nearly black basalt is met with in Middle Creek, where it forms a layer in decomposed rock. This mode of occurrence was not observed by me, and is probably at present obscured by the fluviatile deposits, as is also the siliceous conglomerate referred to by him.

The bed of the main creek from the clays mentioned above to near the northern boundary of allotment 76 contains little else besides pebbles of basalt. In the stream, about 30 yards below the northern boundary of allotment 76, are great masses of basalt boulders; and running parallel with this boundary, and about 3 chains south of it, basalt occurs running up the spur on the west. It is contiguous to massive beds of Jurassic sandstones, but, owing to numerous small landslips which have come away from the spur to the south, the line of contact is completely hidden. Along this contact there is a distinct hollow visible, in which a gully is in process of formation.

The spur of basalt opposite, on the north-eastern side of the creek, is bounded both on the west and on the east by gullies which have been eroded along the lines of contact. That on the west divides the basalt sharply from Jurassic sediments, while that on the east separates it from the Cainozoic deposits.

In tracing the basalt up the hill to the south of Middle Creek, it is found to continue to the top of the ridge in allotment 76, but as the ridge is followed in a south-easterly direction the decomposing basalt gives place to red ferruginous clay containing argillaceous nodules—so extremely like volcanic clay that it might at first sight be mistaken for such.

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* Kitson, Report on the Coast Line and Adjacent Country between Frankston, Mornington, and Dromana. Monthly Prog. Rept. Geol. Surv. Vict., No. 12, March, 1900.

† Deane, Preliminary Report on the Fossil Flora of Pitfield, Mornington, Sentinel Rock (Otway Coast), Berwick and Wonwron. Records Geol. Surv. Vict., No. 1, Part I., 1902.

‡ *Op. cit.*, p. 151.

The general appearance of the occurrence of basalt here leads one to suppose that the flow had fallen over a steep escarpment of Jurassics into an Eocene estuary or lake, or filled up a gorge, the bounding cliffs of which, on the south, have since been completely removed and their places taken by Cainozoic sediments.

Along the contact, between the basalt and the Jurassics, the rocks are grey and brown felspathic and argillaceous sandstones, dipping S. 15° E. at 35°, while at the junction of the next gully to the west the beds are massive ones of coarse sandstones of the same kind.

Where Middle Creek crosses the northern boundary of allotment 76, the channel is, by virtue of the character of the rocks, greatly narrowed, and is, in fact, a small gorge only 50 feet wide. Among the creek pebbles none of basalt occurs, showing clearly that for some distance, at any rate, no basalt is present above the large mass in the creek lower down, and that basalt does not flank the bordering spurs in the vicinity on their fall into Middle Creek.

In following down, from the northern boundary of allotment 76, the ridge of the spur bordering Middle Creek on the south-west, the ferruginous clays already mentioned are in evidence.

Lower down the spur dense whitish siliceous quartz grits become visible, and, still lower, coarse white gravels.

All these sediments greatly resemble those* near Ballar Creek, on the Mornington coast.

On the opposite ridge flanking Middle Creek there occur gravelly sands, while a few chains below the lignite bed, and forming a steep bank of the creek, is a series of white, yellow, and red gravels and sands, about 30 feet thick, apparently dipping S.E. at about 8° to 10°.

A few yards below this section, and in the bed of the creek, a small outcrop may be seen of the same kind of whitish plastic clay as occurs in the bed of the creek higher up the stream than the lignite and near the leaf-bed. From its position here it appears to overlie the lignite. The beds in the bank seem to belong to the same series as the deposits occurring on the ridges flanking Middle Creek, but their relation to the clays is not clear.

The lignite is of firm texture and good quality. Analyses made many years ago of two samples gave the following results :—Percentage analysis by the late Cosmo Newbery—Water, 16·40 ; volatile matter, 38·50 ; fixed carbon, 37·65 ; ash, 7·45. Mr. Newbery reports† that it resembles the Crossover lignite both in appearance and composition. The other analysis is recorded by Mr. Jas. Stirling, name of analyst not being stated. It gave, per cent.—Water, 17·85 ; volatile matter, 40·5 ; fixed carbon, 38·10 ; ash, 3·55.

Neither the extent nor the thickness of the bed has ever been ascertained. A series of bores put down for that purpose in the Middle Creek flats would soon prove the beds in that locality, while an examination would be required of Greig's and Mac's Creeks, the streams on each side of Middle Creek, to see if any lignite is there outcropping, and if the geological features are such as would justify the putting down of trial bores to ascertain whether or not the bed in Middle Creek extends in either direction. There seems no reason to doubt that this is the case. One bore put down in Middle Creek flat would prove the thickness of the bed. The boring would be shallow, through easily-bored strata, and should be done at the lowest rate.

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* Kitson, *op. cit.* † Murray, *op. cit.*, p. 173.

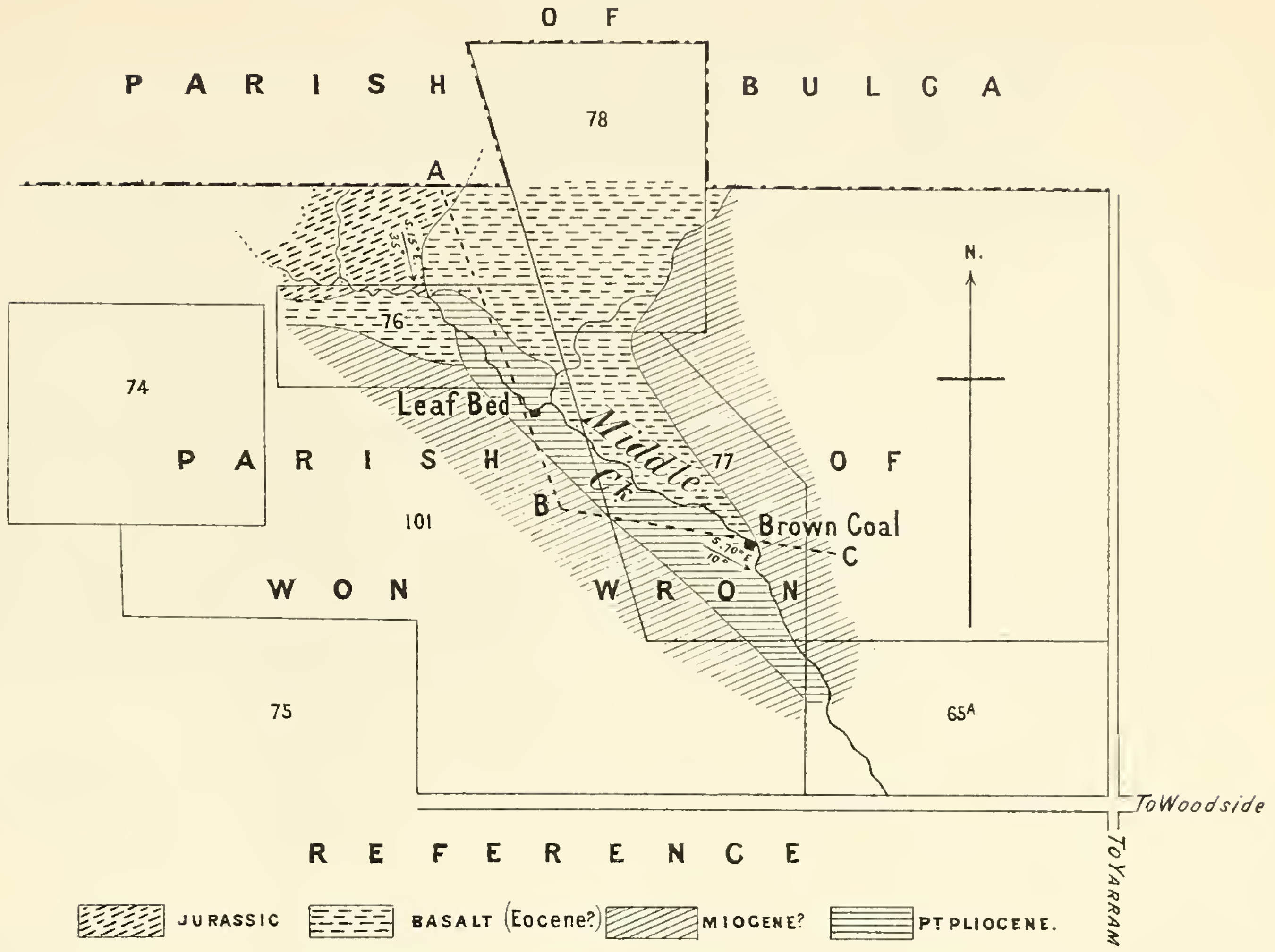
Reviewing the geological formations, it seems as if the lignite is the lowest of the visible Post Jurassic strata, and overlying them come the leaf series (plastic clays, sandy clays, whitish clayey grits and gravels); then bluish-drab and brown speckled clays (probably volcanic ash); and above them dense hard basalt. Overlying these, probably unconformably, the series of red, yellow and white sands and gravels, gravelly sands, siliceous quartz grit, and red ferruginous clays occur. The leaf and other clays series appear to be simply the vestiges of former beds, which may be found intact under the spur of basalt in allotment 78.

If this interpretation is correct, and the lignite and leaf-beds prove to be Eocene, the upper beds are, perhaps, Miocene. I am, however, in a measure, disposed to think they are unconformable, but still of Eocene ? age.

The attached sketch map and sections indicate roughly the geological features of the locality. Sections A–B and B–C are merely provisional ones, as sufficient evidence was not available to state definitely the stratigraphical relations of the rocks to one another.

Geological Survey Camp, Moyarra.
9/3/01.

GEOLOGICAL SKETCH PLAN OF LOCALITY

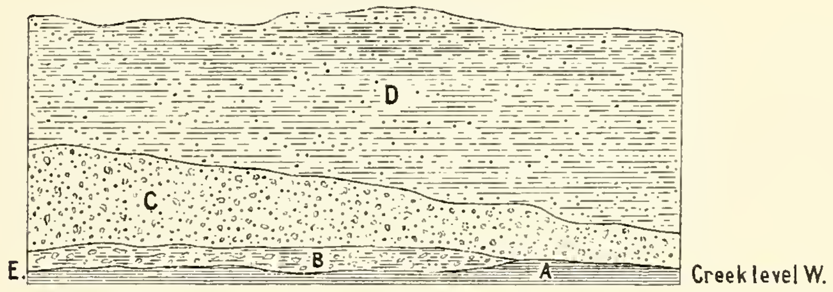


Scale 40 Chs to an inch.

LEAF-BED SECTION

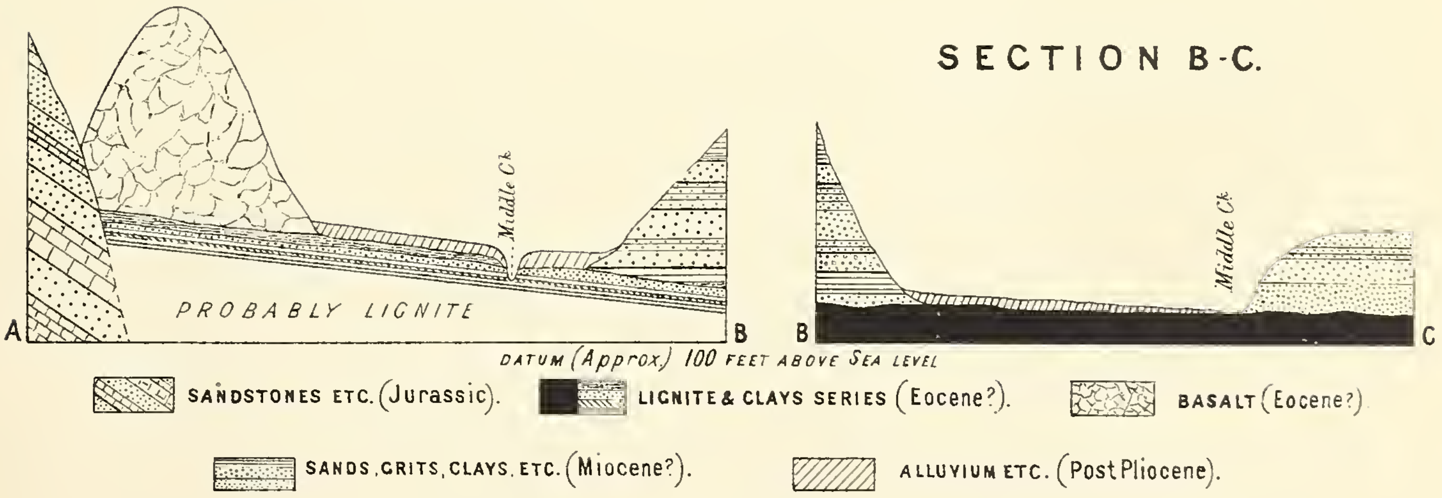
A. Plastic clay. B. Leaf-bearing clay. C. Gravels sands & grits. D. Fluviatile pebbly drift.

Scale Hor. 40 Ft Ver. 20 Ft to an Inch.



SECTION A-B.

SECTION B-C.


Middle Ck
PROBABLY LIGNITE
A
B
B
C
Middle Ck
DATUM (Approx) 100 FEET ABOVE SEA LEVEL
SANDSTONES ETC. (Jurassic).
LIGNITE & CLAYS SERIES (Eocene?).
BASALT (Eocene?)
SANDS, GRITS, CLAYS, ETC. (Miocene?).
ALLUVIUM ETC. (Post Pliocene).

SCALE. Horizontal 20 Chs., Vertical 200 Ft to One Inch.

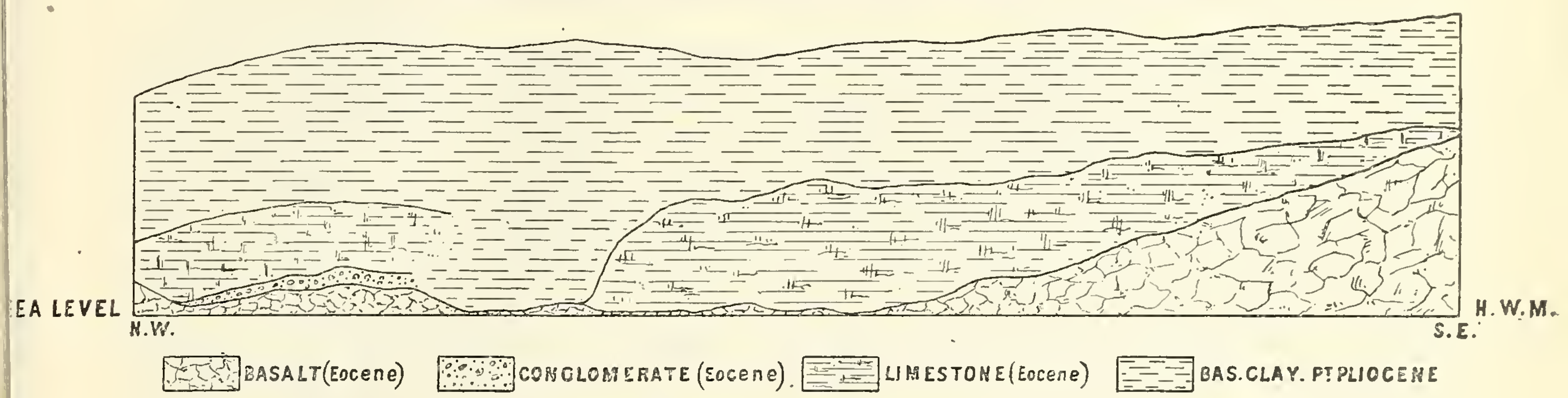
BRITISH MUSEUM NATURAL HISTORY

12.—REPORT ON THE BRYOZOAN LIMESTONE AT FLINDERS.

(*By A. E. Kitson, F.G.S.*)

The exposure of bryozoan limestone at Flinders occurs in a low cliff on the ocean beach, near the point where the extension of the main road from Bittern railway station to Flinders strikes the coast. The cliff section shows basalt at the base, overlain in ascending order by an irregular thin bed of conglomerate, bryozoan limestone, volcanic clay, and, some distance back from the shore, by white blown sand. The accompanying sketch section illustrates roughly the deposit:—

SKETCH SECTION OF BRYOZOAN LIMESTONE AT FLINDERS.



SCALE. Hor. 80 FT, Vert. 40 FT to an Inch.

The basalt stretches out to sea, and the beach at this point at low water is composed of basalt, which for the most part forms a ragged pavement, while in sharp-edged patches here and there the rock stands up from 2 to 3 feet above the general level. It is a fine-grained, hard, dense, dark bluish-grey rock.

In this basalt pavement there are numerous small and large pools left by the receding tide. These range from a foot to several feet in diameter, and have apparently been caused by pot-hole erosion.

Between this low-water beach and the limestone section is a strip of white sand about 20 yards wide.

The basalt immediately under the limestone is greatly decomposed, being almost turned into grey and yellowish-brown clays. It is much jointed in more or less horizontal layers, and in these carbonates of lime and magnesia have been deposited by infiltration.

In the eastern portion of the section exposed, a thin bed of conglomerate consisting of basalt pebbles separates the basalt from the overlying limestone, but in the western the limestone rests directly upon the decomposing basalt. The conglomerate band varies in thickness from 3 inches to 1ft. 6in., and the pebbles of basalt are cemented together by ferruginous clays containing odd grains of water-worn quartz.

The limestone is composed of bryozoa, echinoid spines and tests, calcareous sponges, and foraminifera (such as *Nummulites variolaria*), with fragments, mostly small, of lamellibranchs (such as pectens), brachiopods, a few fragile gasteropods and corals, and an odd shark's tooth. It is of a pure white colour at the base, and yellow and brown higher up, apparently caused by the infiltration of ferruginous water from the overlying volcanic clay and decomposing vegetation. The white portion is a pretty rock, very friable, and crumbles into small pieces when broken, and even by ordinary weathering. The yellow and brown portions are much harder, being slightly ferruginous, and weather into a firm surface. There are several thin, slightly undulating bands, which by infiltration and segregation of carbonate of lime have become fairly dense and hard.

The shells are all so much decomposed that it is rare to get one sufficiently well preserved for identification. Nevertheless, there is a marked scarcity of gasteropods and lamellibranchs, probably owing to their removal by percolating waters subsequent to decomposition.

The bed is especially rich in certain calcisponges, new to science, which have recently been described* by Dr. G. J. Hinde, F.R.S., F.G.S., of London, from specimens sent to him by Mr. T. S. Hall, M.A., of the Melbourne University. One genus is new, while specimens probably referable to another new genus also occur. The volcanic clays overlying the limestone in the cliff are about 20 feet in thickness, and of a dirty dark-grey colour.

This limestone may have been formed in an eroded hollow of the basalt, and the overlying volcanic clays may be the Post Pliocene derivatives from other parts of the same flow brought over by a landslip or by ordinary subaerial transportation before the upper portion of the coast line had been cut away to its present shape. This is a point to be decided only by a more prolonged examination than was practicable during my visit, when only a few hours were available for both collecting fossils and noting the stratigraphy of the locality. Extended observations might lead to the discovery of similar outcrops in the neighbourhood, though as far as noticed the cliffs to the west of the exposure are composed entirely of basalt and volcanic clays, while those on the east running to Black (West) Head at the western entrance to Western Port are of the same nature, but capped with white and yellow sands. These sands are probably portions of the same series as the upper beds in the Mornington district, and, if so, are probably of Eocene age. They are of a loose nature, and where not protected by some surface covering soon form blown sand hills, some of which occur on the highest portion of the coast behind the limestone deposit.

On both sides of this deposit the low cliff recedes and slopes back, and consists of the volcanic clay faced with blown sand.

The cliff on the north-western side is about 200 yards distant along the beach, and undecomposed basalt may be seen here in the bed of a small gully. It does not, apparently, possess much magnetite or titaniferous iron, as these minerals were not visible among the sand on the shore. The soil here is a stiff, dark, drab clay, apparently not of good quality.

The deposit of limestone is only a small one, and seems to have escaped the observation of Mr. A. R. C. Selwyn, as it is neither mentioned by him in his reports† nor marked on the maps accompanying them.

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* Hinde, On Some Remarkable Calcisponges from the Eocene Strata of Victoria (Australia), Quart. Journ. Geol. Soc., Vol. LVI., Lond., 1900, pp. 50-66.

† Selwyn, Geological Surveyor's Report, with plans and sections. Report of the Geological Surveyor on the Geological Structure of the Basin of the River Yarra, and part of the Northern, North-Eastern, and Eastern Drainage of Western Port Bay, with plans and sections. Papers presented to the Legislative Council, Victoria, 1854 and 1856 respectively.

The identifiable mollusca contained in the bed are few in number. The collection made has been examined by Mr. J. Dennant, F.G.S., F.C.S., and the forms identified by him are marked thus (†) in the following list of fossils, while those indicated thus (*) are the forms hitherto recorded from the locality, and included in the list[*] of Eocene fossils by Mr. G. B. Pritchard, republished[†] by the Department of Mines with certain notes on Cainozoic classification by Mr. Jas. Stirling.

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[*] Pritchard, Remarks on the Tertiaries of Australia. Revised and extended by Professor Tate. (Government Printer, Adelaide.)

[†] Stirling, Notes on a Recent Classification of the Older Marine Tertiary Beds of Victoria. Prog. Rept. Geol. Surv., Vict., No. VIII., 1894.

LIST OF FOSSILS FROM FLINDERS BRYOZOAN LIMESTONE.

- Pisces.
  - † Lamna, sp.
- Gasteropoda.
  - † Conus, sp.
  - * Marginella woodsii, Tate.
  - * Turritella, spp.
  - * Liotia roblini, T. Woods.
- Lamellibranchiata.
  - † Pecten gambierensis, T. Woods.
  - *† P. foulcheri, T. Woods.
  - † P. subbifrons, Tate.
- Brachiopoda.
  - *† Magellania garibaldiana, Tate.
  - † Terebratula tateana, T. Woods ?
  - *† T. vitreoides, T Woods ?
  - *† Terebratulina scoulari, Tate.
  - † T. sp.
  - * Rhynchonella squamosa, Hutton.
- Echinoidea.
  - † Paradoxechinus novus, Laube.
  - *† Leiocidaris australis, Duncan.
  - † Scutellina patella, Tate.
  - † Monostychia australis, Laube.
- Bryozoa.
  - Spp.
- Actinozoa.
  - † Conosmilia, *aff.* C. anomala.
  - † Balanophyllia, spp.
- Porifera.
  - † Plectroninia halli, Hinde ?
  - † Bactronella australis, Hinde.
  - † Tretocalia pezica, Hinde.
- Foraminifera.
  - † Nummulites variolaria, Sow.
  - † Other species.

Geological Survey Camp, Moyarra,
11th March, 1901.

13. REPORT ON THE RAPID SURVEY OF AN AREA IN THE BERWICK–CRANBOURNE DISTRICT.

(*By A. E. Kitson, F.G.S.*)

In 1854 and 1855 Dr. A. R. C. Selwyn* made a general geological survey of portion of the basin of the River Yarra, the Mornington Peninsula, and part of the country draining into Western Port.

In the Berwick-Cranbourne district he marked a strip of basalt running southwards from Berwick, all the country round Cranbourne being coloured as Tertiary. Nothing further in the way of a survey appears to have been done in the district until early in 1900, when, on noting from the train an occurrence of basalt near Cranbourne railway station, I was instructed to make a rapid survey of the locality. This led to the examination of the surrounding country, whenever a day was available, on three occasions when passing through it, and it was found that the basalt covered a considerable portion of the parish of Cranbourne. It may be mentioned that Mr. R. A. F. Murray, F.G.S., has recorded† Cranbourne as a locality where "older basalt" occurs, but beyond the record nothing is given.

The country here described is interesting, inasmuch as it possesses features which tend to throw some light upon certain geological difficulties that are met with in the coastal sections on Port Phillip, between Frankston and Mornington.

The formations noted comprise sandstones, mudstones, and claystones of Silurian age; plutonic rock resembling granite, of probably Post Silurian age; breccia-conglomerate, leaf-bearing clays and sandy clays, probably Eocene; "older basalt" (Eocene?); a series of gravels, sands, grits, and clays, some of them ferruginous, and containing casts of Eocene (?) shells in ferruginous clay; lastly, alluvium, drift-sand, and humus of Post Pliocene age. The term "Silurian" is used in a general sense, and not as the equivalent of the division "Upper Silurian" of the Survey, as no fossils have been recorded from the district. It is probable, however, that the beds really do belong to the Silurian, and not to the Ordovician, period.

SILURIAN.

The rocks of this age are, with two exceptions, found either near Berwick, on the Bairnsdale railway, or towards Langwarrin, on the south of the Cranbourne-Tooradin road. In the former case they occur as low spurs running from the Narre Warren ranges across the railway and terminating short distances south of it; in the latter they extend in a north-easterly direction from Mount Eliza through the parish of Langwarrin. On the Melbourne to Sale road, near Narre Warren township, the Silurians are first seen in the road cuttings, and thence to Berwick they are continually in evidence on all the low rises. They are chiefly yellow, grey and brown claystones, and fine argillaceous and arenaceous sandstones. About three-quarters of a mile west of Berwick they dip S. 30° E. at 38°, are fissile, and obliquely jointed, some of the joints being filled with impure pasty silica from which, so Mr. Wilson, of Berwick, informed me, a little gold had been obtained. In the quarry near Berwick, referred to more particularly later on, the Silurian rocks form the base of the hill and are overlain by sedimentary beds and basalt. In the entrance to the quarry the rocks are greenish and bluish-grey soft claystones, greatly jointed, fairly fissile, and dipping from S.E. to S. 60° E. at from 35° to 65°. The hill on which Berwick is situated is also Silurian, with a strip of basalt on part of it. On the Beaconsfield slope the Silurians extend down to the Cardinia Creek flats, and just below the bridge on the Sale road are outcropping on the north-western side of the creek, and in the stream. They are brownish-grey mudstones, much jointed, dipping N. 70° W. at from 10° to 15°, and are thin-bedded with ferruginous bands between the beds. This strip of Silurian extends southwards through allotments 17, 27, 29, B, 30, 31A, and 31B, parish of Berwick. Most of it is seen on the eastern slope of the ridge, but in allotment 29 it occupies the crown. On the Narre Warren–Cranbourne road, between allotments 24 and 25, parish of Berwick, yellow and white claystones are also seen outcropping in the cuttings on the lowest portion of the ridge. They probably extend along the flank of the ridge for some distance on both sides, and are covered with coarse gravels and siliceous grits of Cainozoic age.

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* Selwyn, Geological Surveyor's Report, with Plans and Sections. Papers presented to the Legislative Council, 1854. Report of the Geological Surveyor on the Geological Structure of the Basin of the River Yarra, and Part of the Northern, North-Eastern, and Eastern Drainage of Western Port Bay, with Plans and Sections. Papers presented to Legislative Council, 1856.

† Murray, Geology and Physical Geography of Victoria, p. 93.

On the south of the Great Southern railway there occurs an area of Silurian, forming undulating country covered with a fairly thick forest of manna gum, wattle, prickly box, and various shrubs. The greater part of it is still virgin bush, though here and there orchards exist. The soil is particularly suitable for the growth of certain fruit trees requiring a rather stiff soil and clayey subsoil. Outcrops of rocks are rare, and, almost without exception, are seen in small road cuttings or quarries. The best exposures noticed are in two quarries near the road between allotments 33 and 34, parish of Sherwood. The rocks are yellow and white, thin-bedded, finely sandy and pure claystones, and hard, fine, grey siliceous sandstone with pyrites. They dip N.W. at from 76° to 80°. Thin veins of quartz obliquely traverse the strata. Another exposure in a road cutting about midway between allotments 3 and 27, parish of Langwarrin, shows yellow claystones dipping N.W. at 55°.

The exceptions previously referred to are small inliers found between Berwick and Cranbourne. One occurs in the N.W. corner of allotment 45, parish of Cranbourne, and probably extends across the Berwick-Clyde road, on a continuation of the same ridge. This small inlier has been noted by Dr. Selwyn. The rocks here are pink and yellow soft claystones with rather numerous argillaceous concretions about the size and shape of loquats. Some of them are hollow. The rocks are greatly jointed at about right angles to the cleavage planes, and they dip N. 70° W. at about 34°. The place has been quarried to a considerable extent, but the rock does not make good road material, being broken up too rapidly. The extension westward of this ridge has pisolite only noticeable on the surface, and, as this is found on basalt and Cainozoic grits areas as well as on Silurian, a definite determination cannot be arrived at without the aid of an artificial or a natural section. The inlier is almost entirely bounded by Eocene? clays and gravels. Pleistocene alluvium completes the cordon. The other inlier occurs in the south-western portion of allotment 24, parish of Cranbourne, and near that township. The rocks are yellow, white and red claystones, and fine siliceous sandstone, dipping about N. 70° W. at from 20° to 24°. They are not at all folded or much indurated. Thin veins of white quartz run obliquely across the beds, and not along the cleavage planes, which latter is a noticeable feature among these Silurian exposures. This outcrop also is used as a quarry, and much better stone for road purposes is here obtained. It is a prominent feature of the locality, as seen from the train, and is almost, if not entirely, surrounded by "older basalt." On the eastern side there is a shallow depression covered with a thin capping of humus, underlain by gravelly and clayey sand with siliceous concretions in the shape of small tubes. Basalt probably underlies at a few feet.

Another small rise occurs in allotment 26, parish of Berwick, where the same difficulty regarding definite identification of the deposit presents itself, owing to the absence of fragments of distinct rocks. The area has been regarded as an extension of a Silurian spur, and coloured as such.

These Silurian rocks are auriferous to a certain extent, but as no reefs at all or veins of quartz of any thickness were noticed, there is not likely to be any payable gold ore in the area. Alluvial deposits here and there may possibly furnish a little return for labour expended. It is stated by Mr. Wilson, of Berwick, that alluvial gold has lately been found in Harkaway Creek, north-west of Berwick.

There seems little doubt that the Silurian areas of the northern and southern portions of the district are continuous, and that the great denudation that had taken place prior to the deposition of the Cainozoic basalt and sediments had scooped out a wide channel along the course of the Great Southern railway, leaving the two inliers referred to as low islands in the Cainozoic sea.

A coincidence as regards direction is observable in the dips taken, no fewer than three coinciding in one case and two in another, and, as far as noted, they indicate a syncline having a north-easterly axis.

Plutonic.

The only occurrence of "granite" noted in the area is found in its extreme northern portion, in the parish of Berwick. From here it stretches towards the Dandenong Ranges, and is probably connected with the igneous area in the Gembrook and Monbulk districts. The rock is of medium texture, and is grey in colour. In general appearance it is similar to the plutonic rock found on Mounts Eliza and Martha, between Frankston and Dromana, to the south-west. It is probably of intrusive origin, and has invaded the Silurian sediments, as is the case in the districts just mentioned.

Patches of fine-grained dark rock, with an excess of biotite, are contained in the main mass. I was informed by Mr. Wilson that "granite," covered by clays, may be seen in a railway cutting near Hallam's Road station; but this I was not enabled to examine. On the Melbourne-Sale road, however, in the side channel between allotments 12 and 30, parish of Eumemmerring, is a clay containing particles of quartz and flakes of mica, overlain by yellow, red, and white mottled sandy clays and argillaceous sands, belonging to the Cainozoic series. This is probably decomposed granite, or detritus derived therefrom, and connected with the granite stated to be visible in the Hallam's Road railway cutting, which lies about due south of, and a short distance from, this place. The term granite is applied to this rock only in a general way, as a microscopical examination is necessary to correctly diagnose it.

[Since the preceding remarks were written, Mr. E. G. Hogg, M.A., has published a paper,* in which he describes, *inter alia*, granitoid rocks from this and the Mornington districts. The rock from Harkaway—of which the plutonic rock herein referred to is the southern extension—he speaks of as "fine-grained syenite, showing a white felspar (both monoclinic and triclinic), biotite, hornblende, and much quartz"; while the rocks from Frankston and Mount Martha are referred to as granitite and syenite respectively.]

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* Hogg, The Petrology of Certain Victorian Granites. Proc. Roy. Soc. Vict., Vol. XIII. (N.S.), Part II.

LEAF-BEARING CLAYS. EOCENE ?

In the entrance to Wilson's quarry, Berwick, lying on the Silurian and overlain by basalt, there is an interesting occurrence of rocks, as shown in the accompanying section. The bed next to the Silurians consists of argillaceous breccia-conglomerate, containing angular and sub-angular pebbles, and pieces of claystones and sandstones, apparently derived from the subjacent Silurian rocks. Conformably on these lie white sandy clays, then white pure clays containing indistinct remains of plants. These beds show a steep slope, against which lies basalt in the same way as is the case at Landslip Point, near Frankston.

The contiguous clays are hardened for from $\frac{1}{2}$ to 5 inches from the contact. Whether this induration has in both cases been caused by the basalt or by heated waters percolating through them is not by any means clear.

Overlying both them and the Silurians is a thin covering of volcanic soil, containing pieces of basalt, which has been brought over by subaerial denudation.

The Eocene? beds have no definite dip showing, but judging by their appearance it seems to be a rather high one. They are almost identical in general appearance and succession with the similar beds near Frankston, and may be correlated with them.

Further particulars regarding this locality and others referred to later may be obtained from my report* on the district.

Underlying the basalt in the floor of the quarry are small exposures of yellow, white, black, and brown soft clays and sandy clays, some of them containing leaves of dicotyledonous plants in great abundance. The yellow clays especially are very rich, but they are so much jointed that seldom can a good specimen be preserved. The white clays and sandy clays do not contain so many impressions, or show them so distinctly, but they are in a much better state of preservation. The black clay is very much jointed, and in physical appearance is somewhat like kerosene shale. The joint planes are filled with carbonate of lime, derived probably from the overlying basalt. The thickness of these clays was not observable, but Mr. J. Duncan, foreman of the quarry, informed me they were a few feet thick, while underlying them is a bed of white "pipeclay," 15 feet thick. The visible clays apparently dip about N.E. at about 14°, but as their surface is very uneven, this dip, which was taken on a small outcrop, may be unreliable.

In some places basalt may be seen in depressions up to 10 feet deeper than the level of the floor of the quarry. Though the beds lying against the steeply eroded Silurian face contain indistinct remains of plants, apparently similar to those in the clays in the floor of the quarry; and though there is a resemblance between the two clays, still there does not seem to be sufficient evidence to regard them as portions of the same bed. As work progresses in the quarry more light may be thrown on the matter.

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* Kitson, Report on the Coast Line and Adjacent Country between Frankston, Mornington, and Dromana. Geol. Surv. Vict., Monthly Prog. Rept., No. 12, March, 1900.

The casts of the leaves from the clays in the quarry, and the leaves themselves where sufficiently preserved, have been examined by Mr. Hy. Deane, M.A., F.L.S., of Sydney.*

BASALT. EOCENE ?

This rock occurs in two patches of moderate extent, one at Berwick, the other at Cranbourne. At the former place it occupies the highest portions of the hills, extending for about 2½ miles along the ridge running southwards from the township.

At Wilson's quarry there is exposed a thickness of about 60 feet of basalt; and above this, reaching to the top of the hill, is a further thickness of about 100 feet; so that, assuming basalt to occur the whole way up from the quarry, which it probably does, there is here a mass of about 160 feet of volcanic rock. The rock in the quarry is dense, and light bluish-grey in colour where not decomposed. It is both concretionary and much jointed, with strings of carbonates of lime and magnesia in the joints. Large pockets of clay occur in places. No zeolites were noticed. The rock is decomposed for a considerable depth from the surface in the back of the quarry, and is much splintered. Small breaks are continually taking place, and masses of material sliding into the quarry from this upper portion, which has the appearance of being a distinct flow from that found in the lower portion of the quarry.

The top of the hill is composed of basalt of what appears to be a distinct flow from that or those in the quarry. The rock is here a very fine-grained dense dark one, a typical "older basalt," and weathers into red and brown smooth surfaces and soil; while that in the quarry weathers into dirty-grey soil and surfaces.

In Berwick township some of the rock, evidently similar to that in the quarry, contains large crystals of a glassy mineral. As already stated, the basalt in the quarry lies against a steep face of clay with vegetable remains. The bearing of the line of contact appears to be about S. 70° E., and the angle of slope about 45°.

At Cranbourne the rock occupies country which consists either of low swells, or wide shallow depressions. At the surface loose flattened pieces only, of dense dark basalt, are noticeable among the dark-grey, black, and chocolate stiff loam. In depth it becomes firmer, and is greatly jointed, till at 15 to 20 feet from the surface there is nothing but hard dense jointed rock. It is thus seen in the bottom of a water-course along the Narre Warren road, while in a well sunk in the township to a depth of 40 feet, the section for 1½ feet was a sandy loam, then volcanic clay, decomposing basalt, and finally dense dark basalt. The soil is very rich, and, like that derived from the "older basalt" in most parts of Victoria, eminently suitable for the growth of tubers, especially onions and potatoes, which are largely raised in the district.

The basalt running S.E. from Berwick station appears to be of at least two different flows, judging by the soil, which in some portions of the area is drab-grey in colour and rather poor in quality, but in others is rich in quality, and brown, black, red, or chocolate in colour.

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* Mr. Deane's reports are published in the present part of the Records of the Geol. Surv. Vict.:—

Preliminary Report on the Fossil Flora of Pitfield, Mornington, Sentinel Rock (Otway Coast), Berwick, and Wonwron.

Notes on the Fossil Flora of Berwick.

Along the western foot of this ridge, and again in the wide shallow depressions near Cranbourne, there is a thin covering or blending of ferruginous clayey, sandy, gravelly, and gritty material, with the basaltic soil. This material is evidently derived from once overlying Cainozoic beds, and undoubtedly overlies the basalt; but in only one place was the actual section noticed. This is on the road between allotments 33, parish of Berwick, and 46 and 47, parish of Cranbourne, where coarse gravels overlie the volcanic rock.

From an altitude of about 400 feet on Berwick hill, or, taking the top of the quarry, 315 feet—assuming there to be at least two flows, and the lower one that of which the Cranbourne basalt is part—we find this basalt at an altitude of about 160 feet in a straight distance of about 6 miles, while going on towards the eastern shore of Port Phillip, a further distance of about 9 miles, the basalt shows at sea level, or a little above it. The flow, assuming there to have been one, appears to have travelled in a S. and S.E. direction from the country to the N. and N.W. of Berwick, turning S.W. about Cranbourne, and running out into the area now occupied by Port Phillip. The Silurians of the parish of Langwarrin, lying between Cranbourne and Mornington, have, probably, caused either a split in the flow, deflecting part across the the parish of Sherwood towards Western Port, and the other across the parishes of Lyndhurst and Langwarrin towards Frankston, or directed the whole of it to the S.W.; or, again, the volcanic rock may have gone alike across portion of this Silurian area, and the country on either side now occupied with Cainozoic sediments. These sediments may have been laid down on a more or less deeply eroded surface, from portion of which the basalt was removed either partially or entirely prior to their deposition. In fact, in parts of the parishes of Langwarrin and Sherwood, sands, gravels and clays of Cainozoic age rest immediately on the Silurians.

There seems no reason to doubt that the basalts of Berwick and Cranbourne are portions of the same flow to which belongs the basalt seen on the eastern coast of Port Phillip; therefore, if so, these occurrences are not dykes, as apparently implied* by Dr. Selwyn and the late Professor Sir Frederick McCoy.

EOCENE ?

Under this division is placed a series consisting of siliceous grits, coarse and fine gravels and white sands, ferruginous grits, sands, clays and sandy clays. It is of general distribution through the district, and covers the greater part of the surface.

White sand is seen particularly on allotments 1, 27, 26, 17, parish of Cranbourne; 1, 4, 9, parish of Sherwood; allotment 1, parish of Lyndhurst; and 1, 26, 27, parish of Langwarrin. Clays and sandy and ferruginous clays occur principally along the Sale road, in the parish of Eumemmerring; also in the S.E. corner of the same parish; in the eastern portion of the parish of Lyndhurst; around, and for 3 miles north from, Clyde railway station, with a width of 2 miles; and in the strip in the parish of Sherwood lying between the Silurian area and the Cranbourne-Tooradin road.

Gravels and coarse sands are found over large portions of allotments 23, 24, 25, 35, 36, 37, 38, 39, parish of Berwick. These gravels, derived from coarse siliceous grits, are very similar to the detritus from granite. The grains are distinctly water-worn, though many of them are angular and sub-angular. They have evidently been derived from the plutonic rocks ying immediately to the north, or from some subjacent portion of the same mass. In altitude the ridge covered by these coarse sediments appears to be greater than any of the others on which Cainozoic deposits are present. The argillaceous deposits, though examined as much as was practicable, revealed no fossils with the exception of a few casts in ferruginous clay. This occurrence is in a small cutting on the road between allotments 14 and 15, parish of Lyndhurst, and near the S.W. corner of the former allotment. The casts have been cursorily examined by Mr. J. Dennant, F.G.S., F.C.S., who, however, states that they are not sufficiently definite to admit of determination. With time, a fair collection of casts would probably be obtained here.

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* Selwyn, Progress Report from the Select Committee upon Coal-fields. Papers presented to the Legislative Assembly, 1857, p. 24.

At the bridge over the Eumemmerring Creek, on the Sale road, the Cainozoic shows in section thus:—Grey sand and surface soil, 3 feet; yellow and grey sandy and gravelly clays, 6 feet; medium-grained grey quartz grits and gravels, merging into the overlying clays, 2ft. 6in.; yellow and light grey patchy plastic clays, 3 feet. These last clays are very similar to some of the Wallace Bay clays near Frankston.

About 1½ miles nearer Berwick there are mottled clays, on ferruginous grits, on yellow, red, and white mottled patchy sandy clays, resting on white clayey fine sands, with small cylindrical pieces of brown and drab clays mixed through the white sands.

An interesting occurrence is noticeable on allotment 88, parish of Sherwood, near the S.W. corner of the Caramallam P.R. (allotment 39). It is a small rise capped by about 30 feet of white sand. On the lower portion the plough has turned up large pieces of quartz and smaller pieces of what looks like quartz grit of medium-sized angular pieces of quartz cemented together by silica. Loose pieces of angular, milky and sub-crystallized quartz occur in a bed about 3 inches thick lying on yellow clayey loam about 6 inches below the surface. Still lower down the slope, aboriginal stone flakes have been found at depths up to 1 foot, when sinking post-holes—so I was informed by Mr. E. Waller. Whether this was an old camping ground of the blacks, who collected these rocks together for the purpose of utilizing them as implements, or that it merely indicates that the Silurian rocks are near the surface, is more than I was able to decide.

The country immediately to the west of this place consists of low ridges and points of white firm sand, the intervening portions being covered with a varying thickness of humus, and in winter completely under water. They form the natural drainage into Western Port. This portion of the district has a general appearance very like some parts of the Powlett Plains and Cape Patterson in South Gippsland.

The sandy country just referred to is covered with a thick growth of heath, ti-tree, rushes, coarse grasses, and various small, low, spiny shrubs, with small patches or solitary examples of stunted peppermints and manna gums; while the looser sandy country, and that where much argillaceous matter is present, is clothed with a more vigorous vegetation. The manna gums are especially fine specimens of trees, forming along the Cranbourne-Tooradin road, for many miles, as beautiful an avenue of fresh healthy green trees as can be seen in the State.

As already mentioned, in only one place is the Cainozoic seen in section with the basalt, and that is a small one consisting of ferruginous gravels. Though this is the case, there is no reason to doubt that the clayey beds as well overlie the basalt. In fact, the evidence furnished by the sections along the eastern coast of Port Phillip, and by the bore* put down in 1857 by the Department of Mines near Mordialloc, where basalt was struck after passing through 238 feet of Cainozoic sediments, comprising soft sand and clay, tends to prove that this is the case. The question as to whether or not the upper beds of the Mornington series are conformable to the lower ones, and of Eocene age, is an open one. They are, however, probably Eocene.

From the evidence furnished by the Eocene ferruginous casts at Landslip Point, near Frankston; by the apparent succession of beds on the coast just below the Eocene shell-bearing clays in Balcombe Bay, where the unfossiliferous ferruginous grits, sands, &c., appear to overlie conformably the fossiliferous clays; and by the ferruginous casts in the parish of Lyndhurst, it appears as if the whole of these upper beds, extending from the coast to the flanks of the spurs off the Dandenong and Narre Warren ranges, are part of the same series, and of Eocene age.

It must be borne in mind, however, that though in the opinion † of the late Professor Tate the fossiliferous beds at Beaumaris are of Oligocene? age, Messrs. T. S. Hall, M.A., and G. B. Pritchard urge ‡ that not these beds only, but the whole series extending to Melbourne from Beaumaris are of Miocene age. Should this be settled beyond a doubt to be the case, it is possible that some at least of the deposits in the area dealt with in this report are of Miocene age.

POST PLIOCENE.

Included under this division is a considerable extent of country, consisting of wide flats along the course of a branch of the Eumemmerring Creek, and narrow strips of alluvium and small patches of marshy or low-lying country in different parts of the district. The smaller occurrences could not be properly ascertained in the time available, therefore only the principal portions have been coloured distinctly on the plan.

The majority of the other occurrences lie in the Cainozoic area. The deposits found along the course of the stream mentioned are principally of a clayey nature, and several feet in thickness. The clay has been derived partly from basalt and partly from Silurian rocks, and is covered by a varying thickness of alluvium or decaying vegetable matter, as in the marshy portion near the junction of the stream with the Eumemmerring Creek. Sands and gravels also occur in this creek, and in some of the smaller water-courses. Thin deposits of peaty matter are found in the heath-covered sandy tracts on the borders of the parishes of Sherwood and Langwarrin. In one of them, so I was informed, aboriginal implements, such as stone flakes, hammers, and fish-hooks, were found by Mr. E. Waller.

As regards the occurrence beneath these Cainozoics of any area of Jurassic beds which may contain coal, there is not much evidence upon which to base an opinion. In a bore sunk§ to a depth of 172 or 180 feet in 1857, near Frankston, basalt is reported to have been struck, after having passed through 165 feet of Cainozoic deposits of sands and clays, and several feet of "sandstone of the old Silurian series;" while in the Mordialloc bore already mentioned, basalt was met with at

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* Progress Report from the Select Committee upon Coal-fields, pp. 12, 24, and 31. Papers presented to Legislative Assembly, 1857.

† Tate, On Some Older Tertiary Fossils of Uncertain Age from the Murray Desert. Trans. Roy. Soc. South Aust., Vol. XXIII., Part I., pp. 105–7.

‡ Hall and Pritchard, A Contribution to our Knowledge of the Tertiaries in the Neighbourhood of Melbourne. Proc. Roy. Soc. Vict., Vol. IX., 1896.

§ Prog. Rept. Sel. Com. upon Coal-fields, 1857, pp. 12, 24, 31.

238 feet. Dr. Selwyn, in his evidence before the Coal-fields Committee, is reported* to have held the opinion of the "probability of the existence of a workable coal-field between Port Phillip and the northern shores of Western Port."

Mr. R. A. F. Murray, F.G.S., late Government Geologist, also evidently holds† the view that Jurassic‡ beds possibly occur in this area.

In the light of the evidence furnished by the occurrence of Silurian rocks, at or near the surface, over such a considerable portion of the area extending from Mount Eliza across Langwarrin towards Cranbourne, this area of possibly Jurassic strata is greatly reduced. Still, there is a large extent of country in the parishes of Mordialloc, Lyndhurst, Frankston, Cranbourne, and Sherwood, where such Jurassic rocks may be found.

Taking everything into consideration, there does not seem sufficient justification for the opinion expressed§ by the late Professor Sir Frederick McCoy, that it was useless boring through the basalt met with in the Mordialloc bore, as by so doing the "older slates" would be struck; for instead of the basalt there occurring as a dyke, as apparently is the case in the Frankston bore, it may be flow basalt, and so be lying on coal-bearing rocks of Jurassic age.

The occurrence of Jurassic beds, some of them containing coal, reported by Dr. Selwyn as in evidence between Mornington and Frankston for a considerable distance along the shore and tested by various bores and shafts,‖ which occurrences, by the way, are now only visible in two outcrops of limited extent, prove that these Jurassic beds flank the Silurian and plutonic area between mounts Martha and Eliza, and there seems no valid reason to doubt the possibility of their also occurring on the northern flanks of the same area, though probably, as stated by Mr. Murray, only as "attenuated vestiges," owing to the great amount of denudation that had taken place before the deposition of the Cainozoic sediments.

Rough plan and section are attached.

Geological Survey Camp, Moyarra,
5th March, 1901.

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* Prog. Rept. Sel. Com. upon Coal-fields, pp. 23, 30.

† Murray, Notes *re* Boring for Artesian Wells near Brighton. Prog. Rept. Geol. Surv. Vict., No. VII. Report respecting Boring for Coal at the Carrum Swamp. *Ibid.*

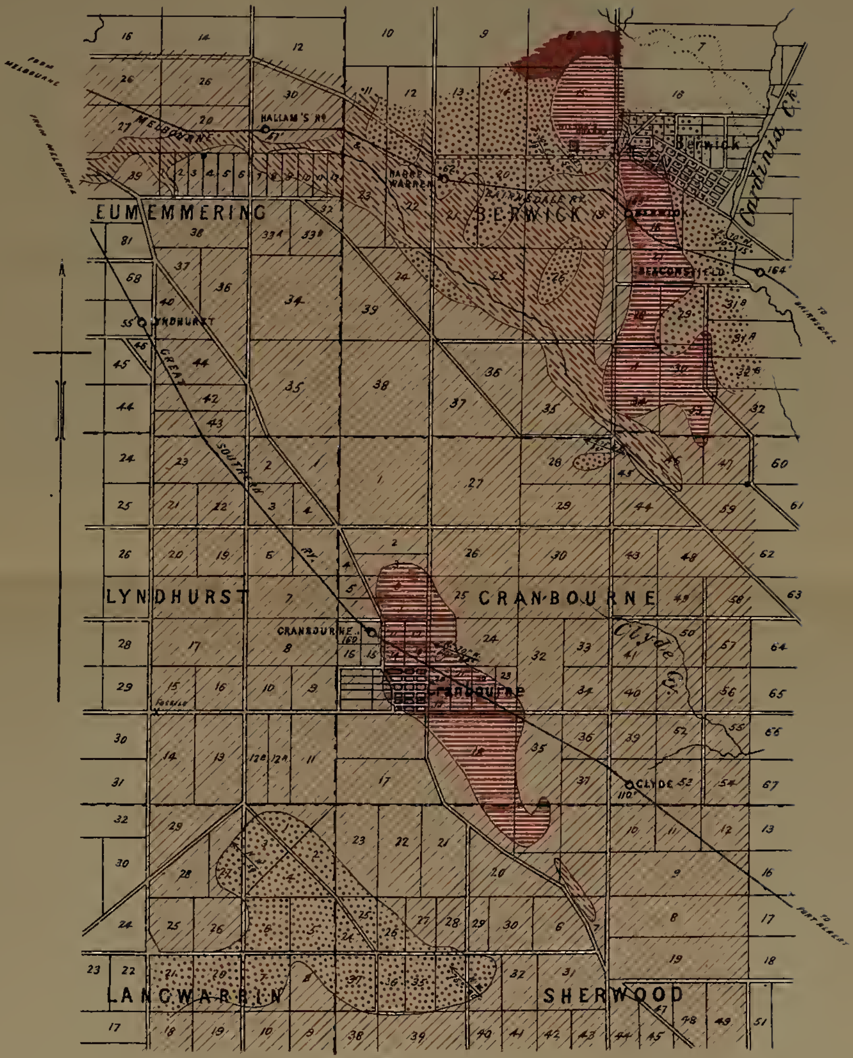
‡ Now regarded by Mr. R. Etheridge, Jun., as Trias-Jura. 31.7.02.

§ Prog. Rept. Sel. Com. upon Coalfields, p. 14.

‖ *Ibid.*

Plan of Rapid Survey
OF PORTION OF THE
BERWICK-CRANBOURNE DISTRICT

SCALE. TWO MILES TO AN INCH.



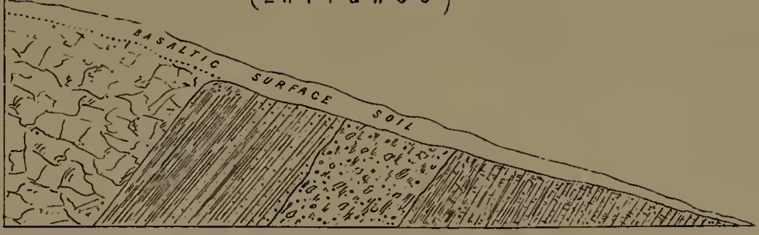
R E F E R E N C E

▨ POST PLIOCENE ▨ EOCENE? ▤ BASALT (Eocene?)

■ GRANITE (Post Silurian) ▦ SILURIAN

Note Heights of Railway Stations above Sea Level thus – CRANBOURNE 160

WILSON'S QUARRY, BERWICK.
(Entrance)



R E F E R E N C E

▨ BASALT (Eocene?) ▨ CLAYS & BRECCIA CONGLOMERATE (Eocene?) ▨ SLATES (Silurian)

SCALE. Hor. 25 FT & Ver. 10 FT to One inch.

BRITISH MUSEUM

14.—REPORT ON THE PROBABLE OCCURRENCE OF COAL IN THE WELSHPOOL DISTRICT.

(*By A. E. Kitson, F.G.S.*)

The country cursorily examined may be roughly described as parts of the parishes of Welshpool and Toora, extending from the northern shores of Corner Inlet to the spurs off Hoddle Range forming the southern portion of the watersheds of the Franklin and Agnes rivers, and Lamont's, Shady, and Nine Mile creeks.

The deposits noticed are placed in five general divisions :—

1. The blown sandhills bordering Corner Inlet, and the marshy portions of the flats.
2. The low messmate-covered sand rises and swelling ground running up to the ranges, and ascending the slopes for some distance.
3. A small area of volcanic rock (basalt) occurring on a spur in the parish of Toora.
4. Areas of limited extent of clays, sands, gravels, &c., capping the ridges in several places, and extending down into some of the valleys.
5. The main mass of the ranges themselves.

The formations taken in descending order of deposition are :—

POST PLIOCENE.

The deposits bordering the Inlet and the marshy portion of the flat country behind it consist of blown sand ridges, bearing coast honeysuckles (*Banksia*) in fair number, and loam and mud flats, covered partly with mangroves and partly with ti-tree, reeds, &c. Near Welshpool the deposits are of no great extent, but they widen considerably towards Port Albert.

CAINOZOIC. MIOCENE ?

The low swells and gently rising country flanking the southern portion of the ranges, and timbered with messmate, yellow stringybark, and occasional bluegums—in the higher portions—consist of lignite, clays, clayey sands, sandy and ferruginous clays and grits, which run up to altitudes of between 300 and 400 feet on the Hedley side of Welshpool railway station, though they are absent from the spurs adjacent to it on the Toora side. These beds are apparently of both marine and lacustrine or estuarine origin. In ascending the slopes the deposits comprise various ferruginous sands, clays, and grits. No fossils of any kind have been recorded from them, and therefore their age is exceedingly doubtful. They are herein provisionally classed younger than beds to be mentioned later solely on the difference in elevation, which is between 200 and 300 feet. In general lithological character and succession of beds they appear to be portion of the same series. They may be unconformable, though still of Eocene ? age.

On the plains, a short distance S.S.E. of Hedley railway station, a bore was put down by the South Gippsland Coal Prospecting Association, with Government aid, in 1862, to a depth of 96ft. 6in., and after passing, according to the records, through a Cainozoic covering of over 50 feet, comprising 1ft. 6in. of surface soil, 14 feet of light brown clay, 3 feet of "quartz sand," 20 feet of lignite, and 14 feet of "fire-clay," struck Jurassic sandstones and shales, stated to contain four "seams" of "black coal." These "seams," it is recorded, vary from 2 inches to 3ft. 4in., and when boring was discontinued the thickest "seam" had not been passed through.*

A few hundred yards to the W.N.W. of Hedley railway station two shafts were sunk many years ago. The deeper shaft was originally a double compartment one and slabbed, but it is now broken down at the surface and nearly full of water. It is said by Mr. Hy. Denham to have been sunk to a depth of about 90 feet, passing through some 12 feet of lignite, and, near the bottom, a small seam of black coal. For 8 feet, from the surface to the water-level, the deposits are bluish-grey and yellowish gritty and fine clays with fragments of lignitic material, and small patches of dark-blue clays. How much deeper the Cainozoic deposits continue could not be ascertained owing to the water. Amongst the débris lying around the mouth of the shaft can be seen fragments of bluish-grey felspathic and micaceous shales and sandstones, the latter being medium-grained, and containing black coal fragments. The greater part of the material, however, lying on the surface around has been quite disintegrated, and has crumbled into clay and loam. The fragments are those of Mesozoic rocks, and their occurrence here, and also further south, as disclosed by the bore, proves that the Jurassics, in this part of the district at any rate, extend well out under the Cainozoic plain. With respect to these "coal seams," it is advisable to quote the remarks made† by Dr. A. R. C. Selwyn, the then Director of Mining and Geological Surveys. He says :—"I have no details of the operations that have been conducted in the district by Dr. Hedley, with the exception of the particulars given me by him of a bore, 96ft. 6in. deep, put down under his superintendence, near the Nine Mile Creek, on the road from Alberton to Corner Inlet. A shaft was commenced under Dr. Hedley's superintendence on the day I left the district, for the purpose of cutting the two seams of coal shown in the above section. When I last heard, the sinking had reached the so-called 2-ft. coal, which, however, proved to be only a mixture of black shale and coal, and not a workable seam. It is to be hoped that the 3-ft. seam will be found, when reached, to be of better quality ; but evidence regarding it, the result of a bore alone, cannot, as I stated to Dr. Hedley at the time I visited the work, be relied on ; and it is therefore premature to offer an opinion on the character of the seam until it has been cut in the shaft. Should it realise Dr. Hedley's anticipations as regards thickness and quality we may fairly assume that it will probably be found to extend over a very considerable area between the Franklin and Albert Rivers. . . ." A section of the bore referred to is published with his remarks. The shaft mentioned by Dr. Selwyn is probably identical with the deeper shaft near Hedley station, already referred to. In the following year an inspection of the locality was made by Mr. C. D'Oyly H. Aplin, who was acting as Director in Dr. Selwyn's absence. In speaking of the boring for coal carried on by the South Gippsland Coal Prospecting Association in the neighborhood of the River Albert, he says‡ :—"Two bores were put down in this locality, but although passing through beds belonging to the coal-bearing series of Victoria, they have not resulted in the discovery of any coal. The same may be said of the further operations carried on by boring at Dr. Hedley's shaft, nearer Welshpool."

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* The deep bore (2,102′ 6″) recently put down shows these records to be quite unreliable.—31.7.02.

† Selwyn, Reports and Papers relative to the Mining and Geological Survey of Victoria, 1863, p. 16. Papers presented to Parliament.

‡ Selwyn, Report of the Director of the Geological Survey of Victoria for period from June, 1863, to September, 1864, p. 15. Papers presented to Parliament.

Basalt. Eocene?

The only volcanic rock noticed, though probably small patches of it occur in other places in the district, is a small area of about 5 acres in Mr. F. Pinkerton's allotment No. 19F, parish of Toora, where it occurs as a narrow strip running from the top of the ridge down the slope a short distance into the valley of Tin Creek. It consists chiefly of a red loam, with nodules of hard dense dark basalt. I was informed by Mr. J. Pinkerton that in sinking a shallow well on the place the basalt was passed through at 10 feet, and "white pug" found beneath. Sinking was discontinued in the pug after 6 feet had been taken out.

On the ridge on all sides of the basalt white quartz gravels occur. The "white pug" evidently forms part of the stanniferous series of deposits, to be described later, found between Shady Creek on the east and the Franklin River on the west.

Eocene?

In the strip of country last-mentioned, and occupying the ridges between Shady Creek, Agnes River, Tin Creek, and the Franklin River, and extending down the slopes into Tin Creek, is a most interesting series of sediments. They consist of a considerable thickness of stanniferous and lignitiferous deposits, comprising various clays, loose and cemented sands, gravels and grits, the clays containing remains of the higher plants in great abundance, though in a bad state of preservation. Besides stream tin, they contain a little fine gold, schorl, pleonastes, zircons, titaniferous iron, and various kinds of pebbles of quartz, and altered sedimentary rocks. They have at various times been mined for tin, and at the time of my visit, early in 1900, operations were being carried on at the Agnes River and the Great Southern (Tin Creek) mines.

On following the divide between Shady and Lamont's Creeks, after passing over some miles of Jurassic country covered with a fine forest of the trees and shrubs characteristic of such soil, one finds, about the source of Lamont's Creek, a sharp and sudden change in the vegetation, which consists of dwarfed messmates and peppermints, with ti-tree, heath, rushes, and coarse grasses. The soil changes to that of a sandy, gravelly and sandy clayey nature, and continues so, with patches of cemented grits, towards the source of the Agnes River. Near where first met with are situated the old open-face workings of the Granite Bar Extended Tin Mine. The deposits here seen, taken in descending order, comprise various kinds of sands, sandy clays, gravels, coarse yellow rounded quartz gravels grading off laterally in some parts to gravelly and sandy yellow and white clays, coated with oxide of iron in joints and casts of included pebbles. Rounded quartz pebbles occur among these gravels, both singly and in thin bands, and pieces of tourmaline are also distributed through them. Then occur white gravelly clays, very much jointed, and looking exceedingly like decomposed muscovite granite. This feature has probably been the cause of the name given to the mine. These beds are about 70 feet thick, and are the ones containing the stream tin. Beneath them are slightly fissile blue clays with vegetable remains and lignite in small pieces; then lilac and grey plastic clays, with unidentifiable leaves, and a few quartz pebbles up to 4 inches in diameter. The beds dip N. at from 16° to 21°. All these clays are greatly jointed, and have a thickness of about 30 feet. Whether they lie directly on the Jurassics, or have other Cainozoic deposits beneath them, was not observed. Some identifiable leaves might probably be obtained here in dry weather, but the heavy and continuous rain that fell during the whole of my visit in this district prevented any good specimens from being obtained.

Following this ridge further north, the Toora tin workings are seen. The visible section in the open face discloses 6 feet of red, yellow, and brown clays with angular quartz gravels, under which lie 14 feet of white and yellowish-grey gravelly clays. The lowest portion of the workings was slabbed, and the deposits, 10 feet thick, therefore, not visible.

A much more interesting section occurs in the Agnes River Tin Mine, on the ridge on the opposite side of the Agnes River. Here is shown a thickness of about 130 feet of Cainozoic deposits lying on brown felspathic Jurassic sandstones.

The series, taken from top to bottom, gives approximate thicknesses of beds as follow:—

Blue clays, yellow, white and grey fine and coarse quartz gravels, 50 feet; quartz conglomerate, ferruginous pebbly cement and yellow clay merging into blue in some places and sharply defined in others—very plastic in lower portion—3 feet; very plastic blue carbonaceous clay, 5 feet; yellowish-grey and fawn carbonaceous clays, some of them at the base approaching a brown coal, 25 feet. These clays show no stratification in section, but scale off in thin pieces on drying. Then come grey clays, getting micaceous and finely sandy, showing slight fissility, 10 feet; obscured deposits, 30 feet, lying on Jurassic sandstone. The sandy and gravelly beds are those principally containing the stream tin and other minerals.

By going right down into the valley of Tin Creek, about 1½ miles from this mine, may be seen the Great Southern Tin Mine, where the following deposits can be traced downwards. The thickness of the beds is approximate:—

Current-bedded yellow, white, and grey clays and gravels alternately, 70 feet; sands and gravels, 20 feet; quartz pebbly drift, 2 feet; gravels, 5 feet; conglomerate and ferruginous quartz drift, 1ft. 6in.; pink and white plastic clays, 20 feet. The lowest 30 feet of the coarser sediments are said to be the richest in stream tin, the overlying beds containing much less mineral. A bore put down by the company in these clays to a depth of 190 feet showed—according to Mr. Wilson—the same clays to about 70 feet; it then passed into blue, yellow, and white "pug," 120 feet, when work was suspended. These clays in the bore and workings resemble those in the lowest portions of the Agnes River and Granite Bar Extended workings, and their position so much below those mentioned is an interesting feature and seems to lend support to the theory of a fault having taken place, with a S.W. bearing, approximating to the course of Tin Creek. Perhaps the boundaries of the Cainozoic deposits contiguous to the Jurassics, and also the abrupt southern margin of the Jurassic hill country, represent lines of great faults during the Eocene period.

This stanniferous series of deposits seems to have been laid down in a deeply eroded surface of Jurassic rocks, as pointed out* by Mr. R. A. F. Murray, F.G.S., and† Mr. Jas. Stirling.

The rocks underlying these beds, both highest and lowest in altitude, are Jurassic sandstones. The origin, therefore, of the tourmaline and cassiterite is interesting, since the nearest tin-bearing plutonic rock known is that at Yanakie Isthmus, Wilson's Promontory, 15 miles away in a direct line to the south-west. All these carbonaceous deposits are probably lacustrine or estuarine, while the overlying coarser ones may be of marine origin.

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* Murray, Report on the Franklin and Agnes River Tin-field, Toora, South Gippsland. Quart. Rept. Dept. of Mines, Vict., Sept., 1890.

† Stirling, Report on the Agnes River Tin-mining District. Quart. Rept. Dept. of Mines, Vict., Sept., 1888; Prog. Rept. Geol. Surv. Vict., No. VIII., 1894.

The similarity between them all and those flanking the ranges is so great that I am inclined to regard them as belonging to the same Cainozoic division, and to attribute the difference in altitude to faulting. As shown by Mr. Jas. H. Wright, in his valuable paper* on an area in the Morwell Valley, faulting on a large scale has taken place during Cainozoic times, and though as yet there seems to be no distinct evidence of great faulting in the Agnes River district, later observations may prove such to be the case. For the present the flanking deposits are provisionally referred to as Miocene.

The occurrence of the white "pug" beneath the basalt on Pinkerton's allotment, and the similarity of it to the white clays found in the stanniferous and lignitiferous series, tends to prove that the basalt is of later age than the sediments, thus placing it apparently with the basalts described † by Mr. Murray, and synchronizing the sediments with the lignite-bearing beds to which he refers.

JURASSIC.‡

The Mesozoic rocks constituting the foundation of the ranges belong to the coal series of Jurassic age, as shown by the fern fossils obtained, the general lithological characters of the rocks, and the structure of the rock masses. They extend for many miles in an easterly and westerly direction, and, in fact, stretch in an almost unbroken mass from near Lang Lang on the west to the sources of Merriman's and Bruthen Creeks on the east. The only breaks along the line of the Great Southern railway may be seen across the valley of the Tarwin River in the Leongatha district, where volcanic and sedimentary deposits of Cainozoic and Recent age respectively occur; and at Foster, where a tongue of the Silurian of Cape Liptrap is found. In the former locality, moreover, the Jurassic beds in all probability underlie the Cainozoic and Recent beds at no great depth, and near Foster the Jurassics overlie the Silurians a short distance back from the foot of the ranges.

In the neighbourhood of Welshpool, on the northern side of the railway line, and in Lamont's and Shady Creeks, the rocks consist of grey, brown and yellow, massive, fine felspathic, argillaceous and micaceous sandstones and flagstones, and greyish-yellow mudstones. Many of them are greatly jointed, and contain fragments of black coal and plant fossils in places. They dip generally from N. to N. 20° E., at angles varying from 1° to 23°.

Fragments of rocks showing *Angiopteridium spathulatum*, McClelland, and *Alethopteris australis*, McCoy, in great profusion may be found in a small gully in allotment 67, parish of Welshpool. Here, also, several specimens of coniferous plants resembling *Araucarites*, as regarded by Mr. Robt. Etheridge, Jun., were found by Mr. George Christensen, who accompanied me over portion of the locality.

The spurs in this southern termination of the ranges have altitudes of between 400 and 500 feet above sea-level.

Further north, towards the source of Nine Mile Creek, the rocks are bluish-grey and yellow mudstones and claystones, containing small patches of black coal and impure clayey coal. These rocks disintegrate into a whitish soil with the black coal showing distinctly in the bedding places. They dip generally S. at from 15° to 26°, and in places have fragments of *Angiopteridium spathulatum*.

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* Wright, Notes on the Geological Features of an Area in South Gippsland. Prog. Rept. Geol. Surv. Vict., No. VIII., 1894.

† Murray, Report on the Geology and Mineral Resources of South-Western Gippsland. Prog. Rept. Geol. Surv. Vict., No. III., 1876.

‡ Now regarded by Mr. R. Etheridge, Jun., as Trias-Jura.—31.7.02.

From the dip observations made it will be seen that the beds on the southern portion of the Jurassic area dip north, while those nearer the sources of Shady and Nine Mile Creeks dip in the opposite direction, thus apparently indicating a trough or syncline in the strata. The Jurassic rocks, however, are disintegrated so rapidly and are covered with soil to such a thickness that natural outcrops are rare except in the beds of streams, and, therefore, without making an extensive series of observations, it is hazardous to draw a conclusion respecting their general physical structure.

From the observations made—assuming the existence of a syncline and the absence of faulting on a large scale—the location of a bore to serve the purpose of testing the greatest thickness of strata in the locality should be chosen somewhere about the middle of the trough.

The evidence furnished by the shafts and bore near Hedley proves that Jurassic strata extend for some distance under the Cainozoic deposits stretching along the foot of the ranges, but it is a matter of conjecture whether they underlie the whole of the flats and Corner Inlet between Welshpool and the granite area of Wilson's Promontory, or that the Promontory granite extends well out under the flats towards Welshpool. Should the former be the case, the possibility of coal seams being discovered would be increased, since a greater thickness of Jurassic beds would be proved, assuming no folding and serious faulting of the strata have taken place.

Besides the question of the presence or absence of black coal seams there is that of the commercial importance of the deposits of brown coal apparently proved by the old Hedley bore. Here at a depth of 18ft. 6in. from the surface a 20-feet bed of it was passed through, and local report states that a 12-feet bed of the same material was found in the shaft in the vicinity. *

Mr. Denham has also informed me that lignite outcrops on the northern shore of Lewis Channel, Corner Inlet, and in the swamp between the Inlet and Hedley. I have not, however, seen either place, nor have the exact locations been defined.

6.9.00.

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* The deep bore recently completed, before entering the Trias-Jura rocks, passed through 270 feet of Cainozoic deposits, including three beds of lignite 70 feet, 5ft. 10in., and 50 feet thick, respectively. Details of bore to 1,477 feet deep in Ann. Rept. Sec. Mines and W.S. for 1901.—31.7.02.

15. REPORT ON RAPID GEOLOGICAL SURVEY OF PARISH OF BUNG BONG, COUNTIES GLADSTONE AND TALBOT.*

(*By Stanley B. Hunter.*)

General Features.

The area within this parish consists of Ordovician hills and Cainozoic and Pleistocene flats.

The Cainozoic includes "Pliocene" basalts similar in character to the basalts covering the Moolort leads, cements occasionally auriferous and not unlike the gold-bearing cemented gravels at Talbot, and deep alluvial leads, the latter being "Lower Pliocene." The Pleistocene comprises all recent deposits of sand, slum, gravels, or clays, in the gullies and along the banks of the Bet Bet Creek.

Fully two-thirds of the parish consist of State forest lands covered with a young growth of various gums, box, and ironbark.

A small area of auriferous cement ("Pliocene"), close to where One-mile flat crosses the road a little west of centre of parish, was worked out some years ago, having proved highly payable.

Alluvial Workings and Deep Leads.

Moonlight Flat.—This heads from the same range as Doctor's Gully, and has been worked down to its junction with the Adelaide lead in parish of Wareek. Occasionally rich patches were found in the wash.

On the eastern portion of the parish many gullies have been worked, such as Whitehorse, Pieman's, Kangaroo, Coppernose, Kentish, &c., some of which join the Daisy Flat lead in the parish of Amherst. These tributaries, by report, were payable.

In the western portion of the parish is a basaltic flow of about 1½ miles in width, under which a lead known as the Madame Hopkins has been proved to extend for over 14 miles. Two lines of Government bores have been put down on this lead in the parishes of Bung Bong and Lillicur (Annual Reports 1890–1 contain records and geological sections of this work). A company was formed to work the lead at the site of the northern line of bores (shown on plan), and a main shaft 18 feet x 10 feet in the clear was sunk to a depth of 212 feet. On this depth being reached the inflow of water became too heavy, and work was discontinued. The New Madame Hopkins Company has resumed mining operations in the shaft originally commenced, and as the gutter traverses generally through auriferous country, and is also fed by tributaries such as Ironbark lead, &c., there is a reasonable possibility that it will in places prove payable. Powerful pumping machinery will be required wherever mining operations are attempted, as the lead drains a very wide area of country, and the water to be contended with will be extremely heavy. As to the course of the lead north of Bung Bong, I have in a previous report† on the parish of Wareek dealt with the question in detail.

A small lead exists under the tongue of basalt extending south-east along the Dunira Creek, and is locally known as Moore's Flat lead, at the head of which a good deal of shallow digging has been done with, by report, payable results, a little gold also being obtained in Doctor's Gully. The workings were continued down the flat, the sinking becoming gradually deeper and the wash at the same time poorer until the basalt was reached, at which point mining operations ceased, owing, I presume, to the inability of the individual miner occupying only a small claim to profitably sink through the basaltic rock. The depth at this point from surface to bedrock is about 70 feet.

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* Plan is published separately.

† Hunter, Geol. Surv. Vict., Prog. Rept., No. 10, 1899, p. 7.

Two tributaries junction with the lead close to where the Bet Bet and Dunira Creeks meet at the present time. The western tributary, known as the One-mile, was payable though patchy, and was abandoned owing to heavy inflow of water. A little gold was also obtained in the eastern tributary, know as Christmas Gully, but only at the head.

A shaft was sunk just west of the junction of Bet Bet and Dunira Creeks, passing through basalt and bottoming at 90 feet. It is reported that payable gold was obtained. This gutter is probably on the course of the One-mile lead.

It is possible that deeper ground exists on the south side of Bet Bet Creek in the alluvial flat, as the mere fact of basalt occupying a certain area parallel to the creek does not necessarily prove that the deepest ground will be found under it. Several attempts have been made by local miners to bottom the ground south of the basalt, but heavy water has always rendered the attempt unsuccessful.

Three bores were put down many years ago to determine the junction of the Moore's Flat lead with a gutter coming in from the west, but they were placed apparently too far north and bottomed on shallow ground. The junction is, probably, south-east of the bores.

ORDOVICIAN.

The rocks of this series in this area consist principally of hard ferruginous sandstones and light blue or green slates, traversed by a few lines of reefs. The strata have a general easterly dip, but in a cutting on the road in the south-east corner of the parish two folds occur (anticlinal and synclinal) close together.

In the eastern portion of the parish I have traced a dyke for about 15 chains on the surface, the width in places being 25 feet.

REEFS.

One-mile.—This reef has been worked to 70 feet, but no information of a reliable character can be obtained; by report it was unpayable.

North British.—Was worked down to 70 feet or 80 feet, averaging 5 dwts. to the ton; underlays west, strikes 4° west of north.

Berkeley.—This reef is very close to the east boundary of parish, but the outcrop is in the parish of Amherst. A shaft was sunk to 80 feet, and reef proved to underlay east, with a strike of 4° west of north. By report, it averaged 5 to 6 dwts. per ton.

Whitehorse.—This is the only reef in the parish worked below water level, the bottom of stopes being at 300 feet. By report it yielded an average of 4 ozs. to the ton, while some crushings gave phenomenally large yields. The reef underlays west, with a strike of 4° W. of N. Large cubes of iron pyrites exist in the cleavage planes of slate associated with reef.

Albert.—This reef has been tried with fairly payable though very patchy results, as much as 6 ozs. to the ton being obtained. The reef is 18 inches wide, heavily mineralized, and worked down to 60 feet.

Nearly all the reef workings were carried out in the early days of mining, and it is difficult to obtain reliable information beyond what is given above.

Most of the quartz observable in this district has a thin casing of oxide of iron or manganese.

With the exception of the operations of the Madame Hopkins Company, there is but little mining being carried on in the parish at present, only a few fossickers occasionally working in the shallow ground.

There is still, however, scope for prospectors with capital in reefing, especially in the eastern or Amherst side of parish; for, although there has been a fair amount of prospecting done in the past, it has not been of a sufficiently extensive character to prove the richness or otherwise at a depth of the lodes in the district.

The topographical survey of the parish was carried out by Mr. A. W. Gahan.

Office of Mines, Melbourne, 20th June, 1900.

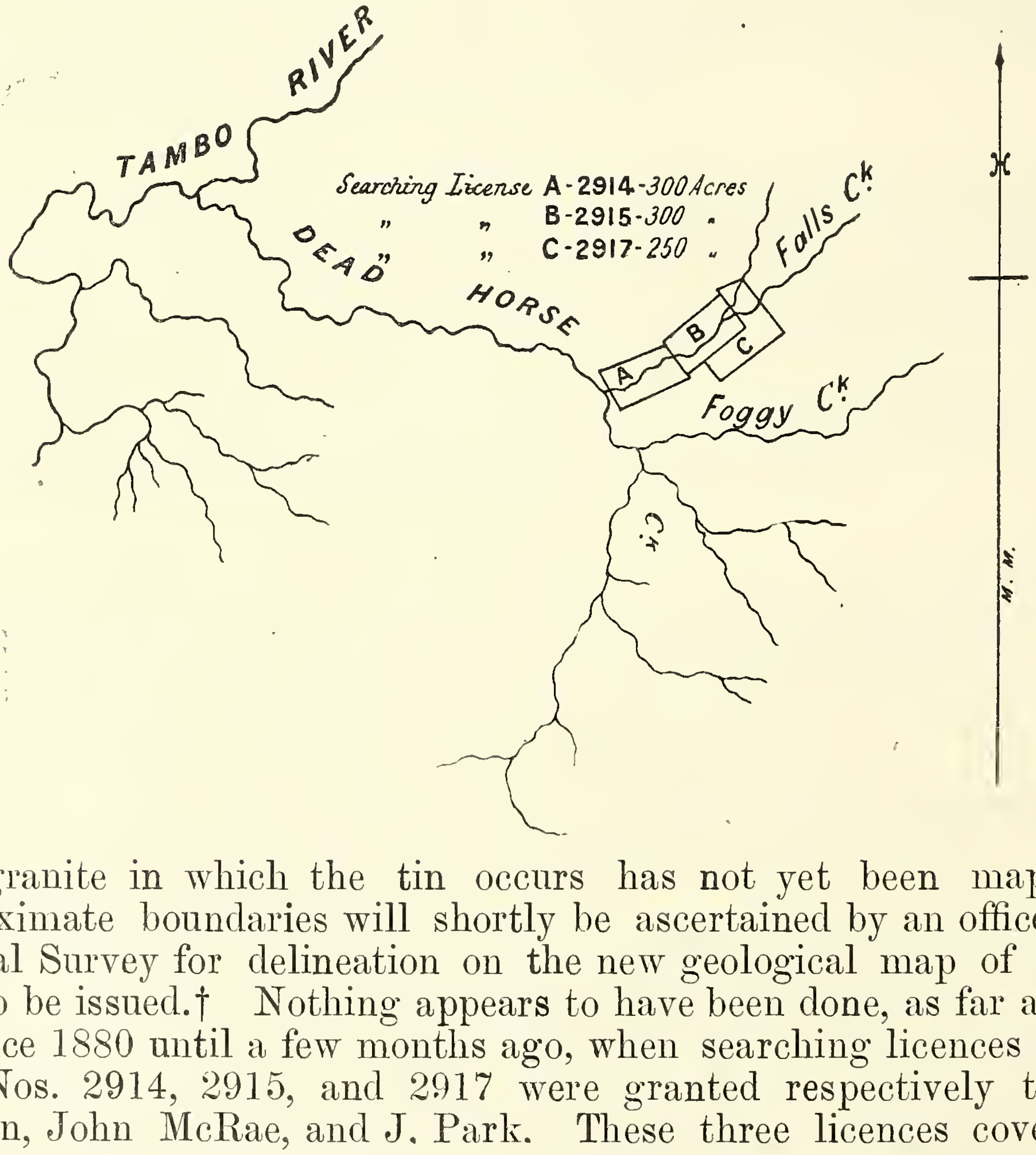
16.—REPORT ON ALLEGED TIN AND GOLD DISCOVERY AT FALLS CREEK, NEAR BRUTHEN.

(*By H. Herman, B.C.E., F.G.S.*)

In accordance with instructions I visited the site of the alleged tin and gold discovery reported at this office last week by Mr. G. Park, of East Melbourne, and found that the prospecting on which that gentleman's statements were based was done about twenty years ago, and that Mr. R. A. F. Murray, F.G.S., late Government Geologist, had reported* on both the locality and the discovery as far back as 1890. I was accompanied by Mr. E. Jarrett, the prospector referred to by Mr. Park as the discoverer, and Mr. John McRae, who, with his partner, Mr. W. R. Mackisson, has recently been prospecting in the locality. Falls Creek, the scene of operations and a northern tributary of Dead Horse Creek, which flows easterly into the Tambo River, is distant about 10 miles in an E.N.E. direction from Bruthen, and may be reached by horse *viâ* either the old Buchan road or the Tambo Valley road and Dead Horse Creek. The area of granite in which the tin occurs has not yet been mapped, but its approximate boundaries will shortly be ascertained by an officer of the Geological Survey for delineation on the new geological map of the State shortly to be issued.† Nothing appears to have been done, as far as I could learn, since 1880 until a few months ago, when searching licences (see plan above) Nos. 2914, 2915, and 2917 were granted respectively to W. R. Mackisson, John McRae, and J. Park. These three licences cover in the

SKETCH LOCALITY PLAN

Scale-2 Miles to the Inch.



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* Murray, Quarterly Report, Mines Department, December, 1890, p. 41.
† Now issued (23/7/02).

aggregate an area of about 850 acres, and occupy a length of about a mile from the junction of Dead Horse and Falls Creeks, along the valley of the latter. The only work visible that is worthy of notice is a shaft sunk (in 1880 by Mr. Jarrett and his son) on S.L. 2915 on an alluvial flat about 15 chains wide, about $\frac{3}{4}$ of a mile from Dead Horse Creek. This shaft, which is now fallen in, passed, Mr. Jarrett informed me, at 30 feet through a 3-ft. layer of loose, brown, fairly coarse, well-rounded wash, giving prospects of $\frac{1}{2}$ oz. to the dish of tin, and bottomed at 62 feet, 3 feet or 4 feet of detritus on the bottom prospecting $\frac{1}{4}$ oz. to the dish. Immediately up-stream from this shaft the alluvial narrows, and about $\frac{1}{4}$ of a mile above, where the creek bifurcates into two fairly steep gullies, granite outcrops continuously along their beds. At the junction of these gullies Mr. Jarrett obtained, he stated, about 9 lbs. of tin and a little fine gold.

On Foggy Creek, the adjoining up-stream tributary of Dead Horse Creek, about $\frac{1}{2}$ a mile from the locality described above, an old shaft, on an alluvial flat about 3 chains wide, was pointed out to me, from the bottom of which, at a depth of 31 feet, 10 lbs. of tin, Mr. Jarrett stated, were obtained. Work was discontinued here, according to the same informant, owing to failure to obtain working capital.

From all the information I could obtain, it appears that the only work done recently was by Messrs. McRae and Mackisson, who spent a couple of months towards the end of last year prospecting over a radius of several miles around the area under special notice. The former stated that he obtained good prospects of tin not only in most of the gullies tried, but also, in many places, in the loam on the slopes of the hills, and an exceptionally good one from the low spur dividing Foggy Creek from Falls Creek, on the fall towards the former.

Prospects from the shallow alluvial in one of the gullies in the Falls Creek watershed, above referred to, washed in my presence by Messrs. McRae and Jarrett, and also by myself, yielded black and ruby tin at the average rate of about 1 lb. per cubic yard.

Regarding future prospects of opening up a payable tin-field, I can add nothing to Mr. Murray's report of 1890, which expresses the general opinion formed by myself. Prospects of tin may be obtained sufficiently good to encourage a further trial of the locality, and, at the present price of tin, fair wages might be made in places in the shallow ground if sufficient water were available, which unfortunately is seldom the case, for sluicing in a small way. With respect to the deeper ground, I would emphasize Mr. Murray's remarks, and point out that before attempting operations on a large scale it is essential, firstly, that the practicability of obtaining a sufficient supply of water at reasonable cost be ascertained, and, secondly, that sufficient prospecting, estimated by Mr. Murray to cost about £200, be done to show whether the average contents of the stanniferous drifts are likely to be payable.

I would also direct attention to Mr. Murray's suggestion that some search be made for the matrix whence the stream tin has been derived, as it is quite possible that good tin-bearing lodes or a "stockwork" may exist in the locality.

Office of Mines, Melbourne, 16/2/00.

17.—REPORT ON PROPOSED DEEP SHAFT ON HUNT'S LINE OF REEF, ELLESMERE.*

(*By H. Herman, B.C.E., F.G.S.*)

The general features of this line of reef have already been briefly set forth by myself in a special report, published by this Department in 1896, and a further report (attached to File 169, M.D. Act, Part I.), dated 1/7/99, furnished in connexion with the applications of the Stewart's United and Ellesmere Consolidated Companies for loans to assist in deep sinking. The present memorandum embodies the salient points of the reports mentioned with a few additional remarks on the probable character of the reef at a greater depth from the surface than is attained by any workings at the present time.

The line was first opened up in 1894, and within two years had been well explored at or near the surface over a length of about 5 miles, several sections of which, aggregating approximately 2 miles, were furnishing ore for the battery. In June, 1896, two shafts had reached a depth of 100 feet, but very little of the material crushed had been obtained deeper than 50 feet. At the same date, about 12,000 tons had been crushed for an average of about 4 dwts. per ton; and while subsequent developments have not resulted in any notable extension of the portions of the line proved ore-bearing at the surface, increasing depth, though not, as far as I could judge from my recent brief inspection, materially affecting the average width of the ore body, has been accompanied by a decrease in the average value of material crushed to about 2 or 2½ dwts. per ton. This decrease in value, however, may be more apparent than real, owing to possible rejection in former years of low grade ore which is now sent to the battery. Stoping and quarrying operations have now exhausted a large proportion of the payable reef to a depth of 80 or 90 feet from the surface, and nearly all workings are approaching or have reached water level.

Owing to several circumstances in favour of cheap mining and milling, such as the considerable width and the usually soft nature of the formation, shallow depth of haulage, the non-refractory and easily crushed ore, and economic management, the small yields have often paid all working expenses, and occasionally even dividends, but the several companies (whose leases now represent the amalgamation of the miners' claims of five years ago) have on the whole derived little profit from their operations, nearly all the gold won having been expended in machinery, stores, wages, and incidental expenses. Operations at Ellesmere, however, which have been almost confined to Hunt's line, have provided employment during the last six years to probably, on the average, about 350 men, which fact of itself renders it clear at the outset that at least a continuance, if not an expansion, of work is an important national desideratum.

An inspection of the field shows only too plainly that unless mining at deeper levels than the present can be made to pay, the existence of Ellesmere as a gold producer and of its considerable mining population will be of very short duration. It can be readily understood, however, that none of the companies, which have done much work for little profit at the upper levels, feels disposed to undertake the task of deep sinking, which, while involving similar expenditure to that necessary for similar tasks on other gold-fields, does not, in view of the (so far) ascertained nature of Hunt's line of reef, offer similar inducement to hope for the discovery of rich bodies of ore.

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* A national shaft is now down 410′ (1.10.02).

Admitting then, on the one hand, the meagre encouragement to any individual company to adopt the rôle of pioneer, and, on the other hand, the national desirability of the continued development of the field, the question arises whether the proposed deep-sinking scheme possesses, notwithstanding the former fact, sufficiently reasonable chances of success to justify the necessary expenditure by the State. In this connexion, I desire to state that the opinion I heard expressed by many at Ellesmere, that Hunt's reef would be found to change in depth to a lode of solid quartz, is not supported by the general features of the formation at the surface. That an important change in the nature of the lode matter will be noted with the attainment of depth is undoubted, but it is just as certain that the portion of the reef above present water-level was, in ages gone by, of exactly the same general character as that below, and now differs from the latter only in the extent to which it has undergone surface decomposition. And while this decomposition would chemically alter minerals like pyrites, galena and stibnite into an earthy condition, rendering them far less easily recognisable to the eye as metallic ores, a solid body of quartz, on being subjected to the action of surface decomposition, would still remain a solid body of quartz. The quartz along Hunt's line of reef, however, occurs as small spurs filling innumerable cracks and joints formed in the beds of slate and sandstone by the rupturing and grinding of enormous rock masses along the line of fissure, and although solid veins of quartz up to 2 feet in thickness have, to my personal knowledge, been found along Hunt's line, I am not aware that any such vein was sufficiently consistent either in strike or underlay to be regarded as constituting a "shoot" of stone of even moderate importance. The natural conclusion to the above is, that if bodies of solid quartz are an essential feature of the line of reef, this feature would be extremely likely to have manifested itself in the appearance of one or more of such bodies in the numerous workings along several miles at the surface; and, *vice versâ*, that the fact of such non-appearance at the surface, though not by any means conclusive proof of the non-existence of important quartz formations at greater depths, certainly justifies the opinion that any discovery of the latter nature must be hoped for as the result of unexpected good fortune rather than a justified anticipation from any visible character of the line of reef at the surface.

What we may reasonably expect to find below water level is that the sandstones and slates will assume the darker bluish-grey appearance of the country rock of the deep mines of Bendigo and other Victorian gold-fields, and the lodestuff, in many portions, a character similar to the "spurry" formations frequently profitably worked in Victoria. Stibnite, as well as pyrites, has already been found in several mines on Hunt's line, and these and other minerals are likely to constitute a considerable portion of the ore body.

That the gold contents for equal areas along the plane of the fissure are likely to vary greatly above and below water level, I can see no reason for believing, but in the latter portion the valuable mineral contents may possibly be confined to a smaller width of formation, and so give a somewhat higher value per ton of ore treated. All these matters, however, will have to be finally decided by the arbiter so often chosen to judge in mining questions—the pick.

Apart from the foregoing considerations, the question whether mining at deeper levels will furnish payable results is affected by—

(1) Increased cost of mining, due to the harder nature of the reef and country below the zone of surface decomposition, and increased expenses for haulage, pumping, and maintenance of workings.

(2) Increased cost of milling, owing to the presence of antimony and other minerals which will require special treatment for the extraction of portion, at least, of the gold contained in the reef.

From all points of view, the problem is one to be solved by experiment only, and a broad consideration of all the circumstances leads me to the opinion that the scheme possesses reasonable chances of success, and that sinking the proposed shaft would be just such assistance to the mining industry as was contemplated by Parliament under section 19 of the Mining Development Act.

Results may or may not prove deeper mining payable, but in either case the experiment will have had its value.

Office of Mines, Melbourne, 2/5/00.

18.—REPORT ON THE NEW BIRTHDAY MINE AT GOLDSBOROUGH, NEAR DUNOLLY.

(*By A. E. Kitson, F.G.S.*)

The main reef in the lease was discovered* in 1867 by a party of men who were making an excavation to hold water for testing the surface deposits in the vicinity. Highly auriferous stone was there exposed, and a mine, the Goldsborough, opened up. Rich quartz was obtained down to 300 feet, from which dividends amounting to £20,000† were paid up to the time operations were suspended. Later on, another company, the Queen's Birthday, was formed to work the same reef on its southward extension. This company sank two shafts, the main one being 1,147 feet, and the other 248 feet, south of the old Goldsborough shaft. After obtaining 100,504 ozs.† of gold down to a depth of about 600 feet, the mine was abandoned until the present company took a lease over the ground. This company has made the northern shaft its working one, and has continued it to a depth of 623 feet. Levels have been opened up at 201 feet, 273 feet, 334 feet, 404 feet, 510 feet, and 610 feet. From the shaft, cross-cuts have been put in easterly to cut the reef, along which drives have been extended at all the levels. In the two lowest levels cross-cuts have been put in for some distance east of the reef also. All the levels were examined except No. 1, which is not at present accessible, being stowed up with material taken from other portions of the mine.

There are two well-defined reefs, known as the eastern or main reef, and the western or Tambaroora, in the ground already explored. Most of the work by the present company has been done on the eastern reef. This reef varies from 5 to 30 feet in thickness, and underlies partly to the east and partly to the west. In the upper levels it underlies east with the strata at high angles with a splendidly defined hanging wall of hard dense siliceous whitish sandstone, plentifully charged with crystals of pyrite, and containing threads and thin veins of quartz. The rock shows considerable signs of alteration, and has somewhat the appearance of some of the more siliceous dyke stones.

This hanging wall, called the "eastern wall," has been traced down to the 400-ft. level, and for a further depth of 50 feet in a winze sunk from that level to the 510-ft. level. At this point the reef takes a roll and underlies to the west as far down as operations have yet been carried out. It may be mentioned, however, that at the cross-cut from the shaft in the 610-ft. level, the reef underlies west in the back of the drive, but in the floor it is rolling over to the east. This is probably merely a small local twist and may not affect the general course of the reef. In the 273-ft. and 334-ft. levels, the reef lies against the "eastern wall" for the whole length of the drives, except at a few places in the latter level where a thin parting separates them, and it consists of quartz, with few, if any, included pieces of strata. At the 400-ft. level, however, it touches the wall only at some places. At this depth the strata are much broken, and the reef consists of a mixture of slate, sandstone, and quartz, forming what is locally termed "a horse of mullock," and the reef material is mostly from a few inches to a few feet away from the wall.

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* Report of the Gold Commission, 1890. Walker, Neglected Gold-fields Report, No. II. Spec. Rept. Dept. Mines, Vict., 1894.

† Records of New Birthday Company, supplied by the legal manager.

In the 510-ft. and 610-ft. levels the reef occurs in this broken country, and underlies west at fairly high angles, while the strata dip to the east; and so wide is the reef that in many parts of the drives the walls cannot be seen on either side. The drive in the former level has broken through into that of the old Queen's Birthday.

In no part in either the cross-cuts or drives in the 510-ft. level has the "eastern wall" been absolutely identified, though it is stated in the report dated 16th July, 1900, of the mining manager to the company, that the "line of wall" has been passed through in the eastern cross-cut from the drive in the 510-ft. level "without proving anything of value."

In several places in the different levels evidence of movement can be seen, both as faults crossing the reef in a more or less transverse direction, when they are termed "cross-courses," or as "slides," when the movement has been along or approaching the plane of strike of the reef. No serious displacement of the reef was, however, noticed in any part of the mine.

There are at least two distinct cross-courses visible in the workings. One may be seen in the 334-ft. level, traversing the cross-cut at the point where it strikes the Tambaroora reef. It has a westerly bearing, and hades N. at about 21°. In the lower level at 404 feet, this same cross-course occurs at a point about 30 feet south of the shaft, and the east and west cross-cuts have been extended along it so that it forms their southern walls.

In the 510-ft. level, about 80 feet N.W. of the No. 2 cross-cut east from the reef, another distinct cross-course may be seen. It bears 110°, and hades N. 20° E. at 30° and upwards. Apparently this same cross-course is met with in the 610-ft. level at a point about 140 feet N.W. of the cross-cut at the south end of the drive. It bears 115°, hading about N. 15° E. at 4°, and has caused a distinct dislocation of the reef, heaving it about 4 feet to the east, with a flucan of 2 to 3 inches of crushed magnesian slates. In this level there are also two irregular "slides," bearing S.E., but the displacement, if any, of the strata is not noticeable.

In the endeavour to find in the lowest levels the "eastern wall" with its contiguous reef of the higher levels, cross-cuts have been driven east from the reef from points about 250 feet south of the shaft, but without success. Assuming that the dip of this "eastern wall" continues regular, and no lateral displacement has taken place, the cross-cut in the 510-ft. level should be almost long enough to strike it, and that in the 610-ft. level should be considerably past it.

The matter of identifying such a bed would not, however, be an easy one, as rock resembling that in the wall is found in other parts of the mine; therefore it may have been passed through in the 610-ft. level without having been noticed. Since no reef underlying E. has been met with in these cross-cuts it is assumed that none occurs on this wall at this depth.

Besides these two reefs there are several small ones showing in the various cross-cuts underlying with the strata or running obliquely across them; but as no gold was visible in them where passed through, they have not been prospected. Though rich auriferous quartz was obtained in the mine by the former company, no payable stone has yet been found by the present company. Trial crushings have hitherto given poor yields; but the last one of 25 tons (just crushed) from the winze in the No. 3 level has returned an average of 6 dwts. per ton.

The strata in the mine comprise dark blue, yellow, white, grey, and olive-green clayey, siliceous, magnesian and chloritic slates; and fine-grained, hard, siliceous sandstone. Many of the beds are highly charged with pyrite in single large crystals, or in bunches of small ones; and through nearly the whole of the beds pyrite crystals may be found, either sparingly or in fair number. Many of the slates are spotted and show considerable signs of alteration in their structure. They contain great numbers of very small crystals forming dark blotches, and in some cases the main portion of the rock is arranged in more or less parallel layers giving it almost the appearance of foliation of chloritic and magnesian schists. The weathered surfaces of the rocks with pyrite crystals have innumerable small pits formed by the decomposition and washing out of the mineral. The spotted sandstones, also, are interesting, and though the rock does not show evidence of alteration to such a large extent as do the softer slates, still it has been altered nearly to a quartzite.

The beds strike regularly from N. to N. 20° W., and dip E. to N.70° E. at from 35° to 86°. The greatest dip appears to occur towards the eastern reef. The quartz forming the reef is chiefly of the white opaque variety, and in the main portion is almost entirely free from minerals of any kind or laminations of rock. Towards the walls, however, in many parts there are thin partings of various slates (mineralized and barren), together with laminæ of minerals, consisting principally of pyrite and galena. A little fine gold and zinc-blende are also distributed through the quartz, and gold along the planes of the laminæ, and also in the quartz. All through the reef at the lower levels there are numbers of vughs ranging from a few inches to a few feet in extent. They usually contain quartz crystals, kaolin, pyrite, silica, and magnesian compounds. Some of the crystals are attached to the main quartz mass, and are either quite clear and clean on the surface, or coated with layers and bunches of pyrite in very small crystals, and with red mud stained by oxide of iron—a ferruginous bauxite. Other crystals lie completely buried in the mass of silica, magnesian compounds, kaolin, and clay, and are thickly coated with pyrite. The formation of the pyrite appears to be in progress at the present time, for in almost any part of the walls of the drives in the three lowest levels, and in the vughs, there is a very thin film of shining metallic mud covering the quartz, quartz crystals, and containing rocks. There is a fair quantity of mineralized water coming out of an overhead vugh in the south end of the drive at the 610-ft. level, and it appears to be highly charged with sulphates of iron and magnesia, &c., thus probably supplying the elements necessary for the formation of pyrite and the magnesian minerals. Analyses are being made* of this water, the red mud on the walls, and the loose material in the vughs, to see if gold and the other elements are contained therein. In many places, also, of the drives, and in some of the vughs, there is a thin efflorescence of what is probably epsomite (sulphate of magnesia), and a single crystal of dolomite (carbonate of lime and magnesia) was found on quartz in a vugh. The quartz in some parts of the reef is greatly broken by small horizontal, transverse, oblique, and longitudinal joints; in others it is considerably splintered and crushed. The joints in other places run longitudinally for some distance, making fine planes, and giving the rock the appearance of having a number of distinct walls. Again, in the upper levels it divides up into what may be termed splices about 1 foot thick, with thin partings of clay (pug) between. The strata in the mine are greatly jointed in some parts, the joints simulating, respectively, cleavage planes and hanging walls very closely when conforming in dip and bearing to them.

About 100 feet east of the shaft of the old Goldsborough mine a very fine example of dark carbonaceous slate containing large single crystals of pyrite was found on the refuse heap. This bed is said by Mr. Jas. Watts, acting mine manager, to have had a distinct influence upon the gold in the reef, for wherever the reef was found in contact with it, the richest gold was present. The bed has not been struck in either of the mines to the south.

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* See Appendix.

THE TAMBAROORA REEF.

This reef has been worked in the upper levels down to a depth of about 350 feet, viz., 330 feet in the levels, and 20 feet by underhand stoping. Some rich stone was obtained therefrom, according to information supplied to me by the company. The reef bears a little west of north, and underlies towards the west at about 27°, judging by the working of the stopes. The shoot of gold apparently pitches to the north on the northern side of the cross-course already alluded to.

In the No. 1 (201-ft.) level, this reef lies east of the shaft, but cuts through it at the No. 2 (273-ft.) level, and has been stoped out for a considerable distance south of the shaft, and for a few feet north of it. At the cross-course referred to the reef was about 6 feet thick, but on being followed in a northerly direction it gradually narrowed, became broken and interlaminated with strata, and finally, at the face of the drive, consists only of a series of thin veins, the main reef running underfoot.

The same feature is noticeable in the eastern reef at the 273-ft. level, in the face of the drive going north from the end of the cross-cut east of the shaft. Here the reef was 6ft. 6in. thick, with a well-defined hanging wall, but it runs out into a thin vein 3 inches thick at a point 36 feet north.

The Goldsborough Company, however, is said by Mr. Watts to have worked a reef on this same hanging wall to a depth of 300 feet, and as that shaft is 248 feet N. of the New Birthday, it is only reasonable to infer that the reef resumes its ordinary character and thickness a little further on. This same company, according to Mr. Watts, cut a reef 2ft. 6in. thick, supposed to be the Tambaroora, in a cross-cut west of its shaft, and though gold is said to have been showing, it was never worked.

Now, as regards the characteristics of the reefs in the Queen's Birthday mine, it is particularly unfortunate that, owing to the inaccessibility of the workings, no inspection could be made. It appears that the material that was stowed in the stopes between the Nos. 2 and 3 levels was allowed by the old company to fall through into the No. 4 level to act as filling for it, with the result that the ground gave way under a dam on the surface immediately overhead, and the workings were flooded with water and sludge, thus rendering their examination impracticable. All the conclusions arrived at, therefore, are based only upon such information as was obtainable locally from old plans of the company, from Mr. Watts, the acting mining manager, and from others who had worked in the mine.

Down to a depth of about 420 feet, the eastern reef, ranging from 4 to 10 feet thick, underlying east, and conforming to the dip of the strata, was lying against the same hanging wall as is found in the upper levels of the New Birthday mine, but at this point it took a roll and was underlying to the west, apparently in exactly the same way as shown in the winze between the 404-ft. and 510-ft. levels in the New Birthday mine. In the 527-ft. level of the old mine a quartz vein, 2 inches thick, is said to have been found against the wall, but at the 720-ft. level, in a cross-cut going east, the hanging wall without any quartz on it was passed through at 85 feet.

As the physical features of the reef in the same levels of these two mines are so similar, and as in the lowest cross-cut in the Queen's Birthday mine no reef was found in contact with the bed forming the hanging or eastern wall, it may be fairly assumed that no such reef occurs.

From the information found in the records of the company, it appears as if the quartz in the 527-ft. and 627-ft. levels was payably auriferous, and that the shoot of gold was dipping north at a fairly steep angle into the New Birthday ground. If this is so, then the matter of ascertaining whether or not the shoot continues far enough north, and deep enough, to run near the New Birthday shaft, is very important. To prove this the shaft might be sunk at least 200 feet deeper, and cross-cuts made as required. As the reef is now underlying west, and therefore towards the shaft, the lengths of the cross-cuts should be less than those in the 5 and 6 levels, assuming that the direction and amount of the underlie remain as at present known. In that case there is a probability of cutting the reef in the shaft at a depth of about 700 feet, though that is not likely to be deep enough to strike the shoot of gold that was worked in the Queen's Birthday mine from its main (southern) shaft.

As far, therefore, as can be judged from the open workings in the New Birthday mine, and the information supplied with regard to the closed workings of this and the Queen's Birthday mines, it seems advisable to suspend the cross-cutting operations which are being carried on to the east of the reef in the two lowest levels in the hope of finding the "eastern wall" with a contiguous reef, and to resume sinking the shaft so as to strike the eastern reef at a depth sufficient to admit of the probability of finding the shoot of gold worked so profitably in the Queen's Birthday mine.

It may also be suggested that the Tambaroora reef be further prospected by small trial crushings from the end of the northern drive in the 334-ft. level, and the drive extended a little further to see if the quartz shows indications of resuming its former thickness.

It is stated by Mr. Watts that in the Tambaroora reef payable gold was not found south of the cross-course in the No. 3 level, or in the eastern reef north of it; but, although the cross-course has probably had some direct bearing upon the distribution of gold in the reefs, there is not sufficient evidence to hand to confirm the opinion that it has so influenced it. Therefore, too much importance should not be attached to such a theory in connexion with future mining operations here until more evidence in support be obtained.

Rough plans of lease and workings, and sections showing the eastern reef, are submitted herewith.

Office of Mines,
Melbourne, 26th November, 1900.

APPENDIX.

Examination of Samples made at the Mines Department Laboratory.

(By H. C. Jenkins, A.R.S.M., &c.)

Samples Examined.	Result of Examination.
Loose material from vughs in quartz reef	Silicates of alumina, iron, and magnesia, with a trace of alkalies.
,, ,, ,, ...	A fine, almost pure, kaolin.
Coating on walls of drives, &c.	Ferruginous bauxite—a brown powder. The substance showed $Fe_2 O_3 . Al_2 O_3 + H_2O$ by qualitative analysis and must, provisionally, be viewed as bauxite.
A greenish slate ...	Analysis gave the following percentages :—

Silica	44·02
Alumina	35·89
Ferric oxide ...	2·44
Ferrous oxide ...	1·70
Copper	Nil
Magnesia	Trace
Antimony oxide ...	0·73
Soda	8·64
Potash	2·42
Water	5·12
	100·96

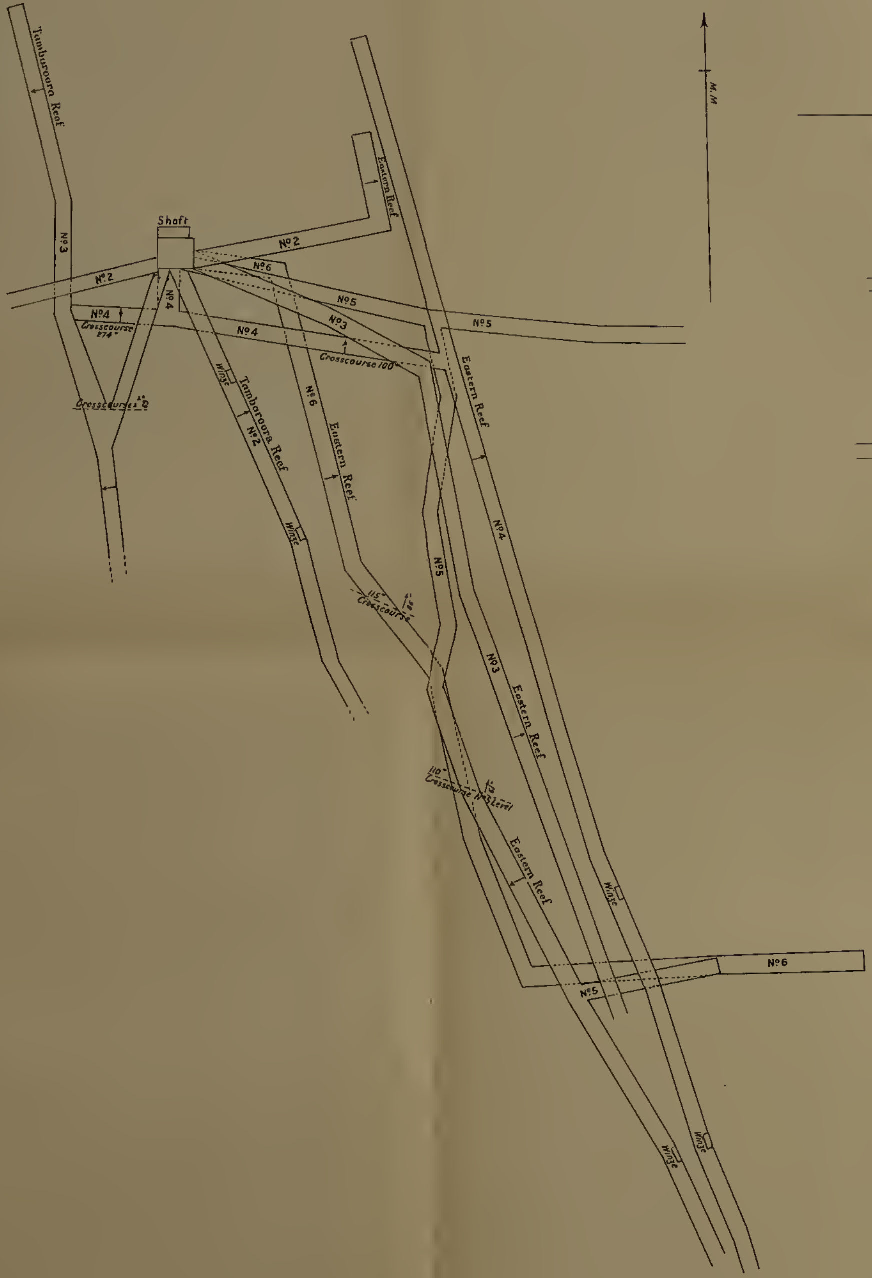
Mine water	Total solids, 17·8 parts per 1,000 (1,246 grains per gallon) Fixed solids, 16·8 ,, ,, ,, (1,176 ,, ,, ,,) Analysis of solids shows percentages of :—

Silica	·003	Quantities referred to the amount of water.
Ferric oxide Alumina ...	0018	
Lime	·0173	
Magnesia	·1395	
Soda	·242	
Potash	Trace	
Sulphur	·0556	

Plans and Sections of the New Birthday Gold Mine, Goldsborough

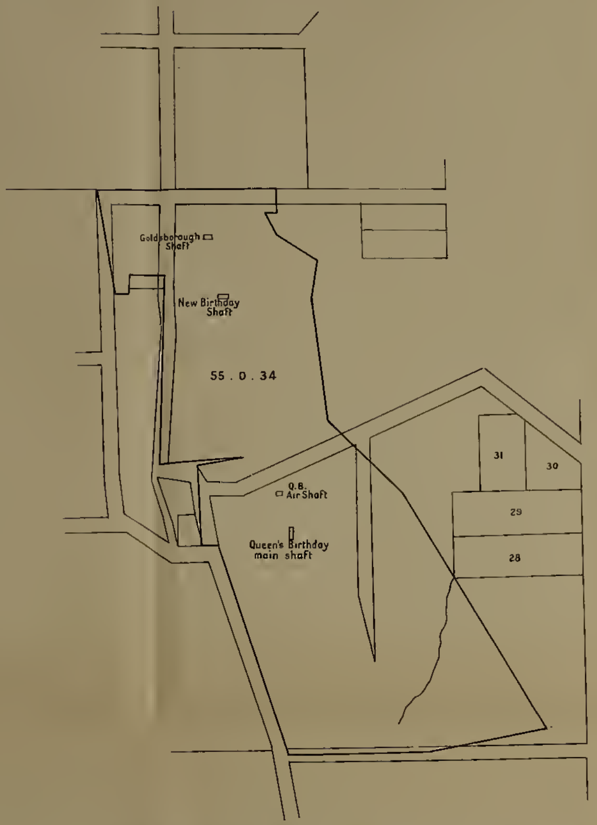
Plan of accessible underground workings

Scale — 40 Chains to 1inch



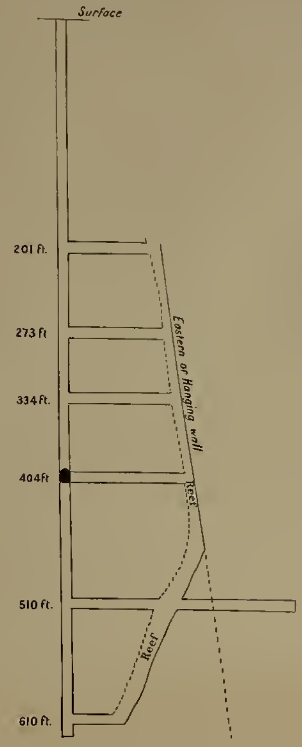
Plan of Lease, Parish of Painswick

Scale — 8 Chains to 1 Inch.



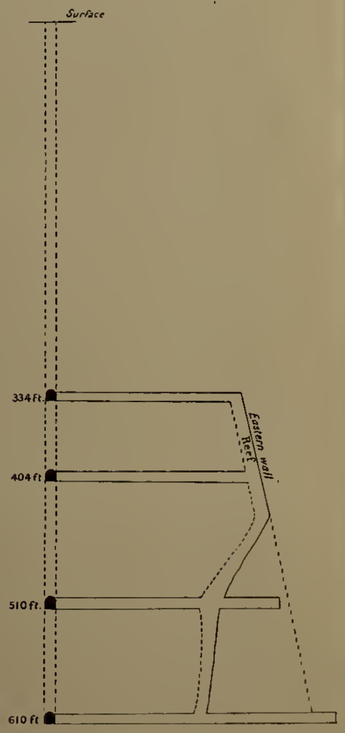
Section of Eastern Reef as proved by Northern Crosscuts.

Scale—Hor. and Vert. 100 Feet to 1 Inch.



Section of Eastern Reef in Southern Drives, 250 feet S. of the shaft

Scale —Hor. and Vert. 100 feet to 1 inch



19.—REPORT ON THE GREAT NORTHERN PARKER'S LINE OF REEF (NEAR GORDONS).

(*By A. M. Howitt.*)

The Great Northern Parker's line of reef is situated in the parish of Korweinguboora (counties of Talbot and Grant), about 8 miles north of the mining township of Gordons, and a little over a quarter of a mile north-west of the junction of the Eastern Moorarbool River and Gum Creek, in the Wombat State Forest.

Mr. H. S. Whitelaw, in a cursory examination of the locality in July, 1900, pointed out that the Great Northern Parker's reef might be the western leg of a saddle formation, the cap of which had been denuded.

I was instructed, in accordance with that gentleman's suggestion, to make a more detailed examination, in order, if possible, to satisfactorily decide the question.

My work was accordingly confined to a detailed examination of the area shown on the plan accompanying this report, and to a cursory examination of an area of about four square miles of the surrounding country.

GEOLOGY.

Cainozoic.—Recent deposits of sands, clays, and gravels form the alluvial flats along the Eastern Moorarbool River, Gum Creek, and their tributary gullies. Deposits, provisionally classed as of Pliocene age, consisting of sands, clays, gravels, ironstone cement, and boulder wash, fringe and cover the lower slopes of the Ordovician slates and sandstones adjacent to the Eastern Moorarbool River and Gum Creek. These have no bearing on the particular object of my report, and will not, therefore, be further referred to here.

Ordovician.—These beds, which consist of dark to light slates and sandstones, coarse grits, and some indurated beds of sandstone, are, owing to the surface soil, seldom clearly exposed at the surface, so that my observations were mostly directed to the hill summits and old workings along and adjacent to the line of reef. The strike is nearly north and south (magnetic) except near the Jones-Bradford mine, where it is a little west of north ; and, wherever noted, the dip was from 40° to 60° westerly, including one observation at about 250 feet east of Atterbury's shaft (see plan).

The reef, as seen in the workings, wherever accessible at present for examination, is conformable with the inclosing beds, and has generally clean slate walls.

Whether the westerly country extends for any considerable distance east of the line of reef cannot be definitely stated, owing to absence of outcrops ; but that such is probably the case is indicated by the fact that on the Moorarbool River, about 1 mile south-south-east of Atterbury's shaft, and about 28 chains east of the southerly continuation of the Great Northern Parker's line, a dip of 50° westerly was again noticed.

The above evidence, although not conclusive, is against the assumption that the Great Northern Parker's is the western leg of a saddle reef.

I was informed that no work had been done on the main shoots for over twelve years on account of the local battery having been burnt down ; and to cart to Daylesford and crush the stone then being mined would not have left a fair profit, so work was discontinued. The quartz reef is of narrow width, averaging 3 to 4 inches as now seen in the workings ; and shows laminations, which, when numerous, give it a grey appearance.

As before stated, the strike is nearly north and south between the Eastern Moorarbool River and the end of the Great Northern Parker's shoot, between which points the reef is most regular.

From here to the Jones-Bradford mine, a distance of over a quarter of a mile, the reef has not been traced ; and although a great deal of prospecting has been done at and about Atterbury's shaft, I consider more prospecting and trenching west of the latter might cut the reef.

The Jones-Bradford portion of the line is not so regular as the Great Northern Parker's, and the average strike is about N. 8° W. (magnetic).

On the south side of the Eastern Moorarbool River, as the plan shows, some prospecting has been done, but nothing of value proved.

In the south workings, nearly opposite A on plan, a parallel make of laminated stone has been opened up for a few feet, whence a trial crushing of 3 tons returned 2½ dwts. per ton. A parallel similar make occurred, I am informed, near the northern workings, opposite C on plan, but in each case the underlay of reef was westerly.

I could not examine the deep workings on account of most of the shafts being refilled with mullock, and in many cases with water, but the following information, most of which is on the authority of Mr. Jones, the original prospector, to whom I am indebted for much information and assistance in locating the old workings, may be useful :—

Name.	Position	Size of Reef.		Stated Crushings.		Remarks.
		As seen.	Reported.	Tons.	Dwts.	
					Per ton.	
I. Jones' shoot	A few chains north of the Eastern Moorarbool River	1″ to 2″	3″ to 5″	7 8 6	9 7 24	This shoot is supposed to pitch north, and has been worked for 100′ along the surface, and to 30′ deep. A 60′ underlay shaft has been sunk.
II. Intermediate shoot	Between Nos. I. and III. shoots	2″	2″	6 1	13½ 2ozs.	This shoot pitched north, occurred in a narrow quartz and pug vein, was worked to a depth of about 15′, and traced for 60′ along the surface. One shaft was sunk 60′. See section B on plan sheet.

INFORMATION—*continued.*

Name.	Position.	Size of Reef.		Stated Crushings.		Remarks.
		As seen.	Reported.	Tons.	Dwts.	
					Per ton.	
III. Great Northern Parker's shoot	Situated about 24 chains north of the Eastern Moorarbool R.	3″ to 4″	4″ up to 10″	It is stated that many tons were crushed for an average of 2ozs. per ton		In the south portion of this shoot, which extends over 300′ in length, nearly opposite the main shaft the stone is stated to have averaged 4″ in width, and to have been stoped from 180′ to the surface; in the north portion the stopes are in places from 20′ to 70′ deep. A portion of the reef was payably worked by tributers to 40′, below which level good stone is reported to have been left. The main shaft is about 80′ west of the outcrop, and has been sunk to 240′. At 90′ an east cross-cut 45′ cut the reef, and 200′ was then driven north. At 160′ the reef passed through the shaft, and at 240′ a 50′ cross-cut west cut the reef, but no driving was done. The shoot is stated to have pitched north. Water level was 60′.
IV. Jones-Bradford shoot	About 24 chains north from where the Gt. Northern Parker's shoot was lost	1″ to 2″	4″ up to 1 foot	It is stated that the average return was 2½ozs. per ton; best 5½ozs. per ton; poorest, 10dwts. per ton		The main shaft is about 110′ west of the reef outcrop, and has been sunk to 180′, passing water level at 60′. For about 270′ along the surface the reef has been worked to depths of 20′ to 70′, and, as stated, to 180′ in the main shaft. In the north workings, opposite the main shaft, a cross-course was met, but the reef was hardly, if at all, displaced. I am informed that 10dwt. stone was taken out north of the cross-course. Reported pitch of shoot, north.

FUTURE WORK.

The site for any future work should, I consider, be on the Great Northern Parker's shoot, as here the reef has been most regular, and has already been worked to a depth of 240 feet.

If it be accepted that the reef is not the western leg of a saddle, as seems most likely, future work should be west of the outcrop, for which purpose two schemes may be suggested :—

Scheme (I). Working from the old shaft to cut the reef at 500′ would necessitate sinking 260′ deeper, and cross-cutting about 220′, where the reef would probably be cut, and driving could be done. This would be the cheaper if the maximum depth to which work was contemplated were 500′.

Scheme (II). To sink a new shaft, say, 200′ west of the old one, necessitating 540′ of sinking to reach the reef at the same point as in scheme (I). For mining to a depth exceeding 500′ this would be the preferable scheme. (See accompanying sketch sections.)

In conclusion, I may mention that the reefs appear to have shed very little of their gold to feed the several alluvial runs that have been opened near the Great Northern Parker's line of reef, and the small amount of work done has proved little of importance, except at Forty-Foot Lead, where coarse wash was proved, from which an encouraging prospect was washed in my presence. This lead is worthy of further prospecting.

Office of Mines,
Melbourne, 4th February, 1901.

20. NOTES ON COMMON OPAL DEPOSITS IN EAST GIPPSLAND.

(*Extracted from Report by W. H. Ferguson.*)

Common or milky opal occurs in a number of places in the Gelantipy district, the largest deposit being situated at "W. Tree," on the Gelantipy to Buchan road, where a shaft and an excavation, both partly fallen in, disclose opal between 1 and 2 feet thick; the mode of occurrence cannot, however, be clearly seen. The rocks of the neighbourhood are porphyry, of the Snowy River fragmental series, and basalt, which rests on the porphyry, and in which the opal apparently occurs.

Portion of the basalt is very vesicular, and the vesicles are in places filled with zeolites, and chalcedony of a white and light-blue tint. Some of the amygdaloidal basalt has a fine appearance, and would doubtless take a handsome polish.

From Buchan to Deddick, along the Snowy River valley, there is abundant evidence of the deposition of minerals from solution. The porphyry in various places contains veins of barium sulphate, jasper, quartz and calcite, and deposits of agate.

If the deposit at "W. Tree" were properly opened up, blocks 2 feet in diameter could be obtained. On the surface, the stone is much flawed and jointed; in depth, solid stone could probably be obtained. The colour ranges from milky-white, yellow, brown, and red to black, and is beautifully streaked and mottled. Some of the stone decomposes freely at the surface. No precious opal was noticed in the deposit; it is locally reported that such has been obtained. In places, a superficial iridescent decomposition tarnish may be seen, but no deep-seated play of colours. The stone is apparently susceptible of a very high polish, and could possibly be used in the manufacture of clock-stands and other useful and ornamental articles. A few excavations would prove the extent of the deposit, and enable samples to be obtained with the view of ascertaining whether it is likely to be of commercial value.

Similar opal is reported to exist at Fanwick and other localities eastward from "W. Tree," and to be associated with basalt and granite.

Common opal occurs in the Western District of Victoria, near Mount Staveley and the township of Wickliffe, where it occurs in porphyry, and in Ordovician strata in contact with porphyry.

Kilcunda, 20th February, 1900.

PRESENTED
12 JUL. 1904

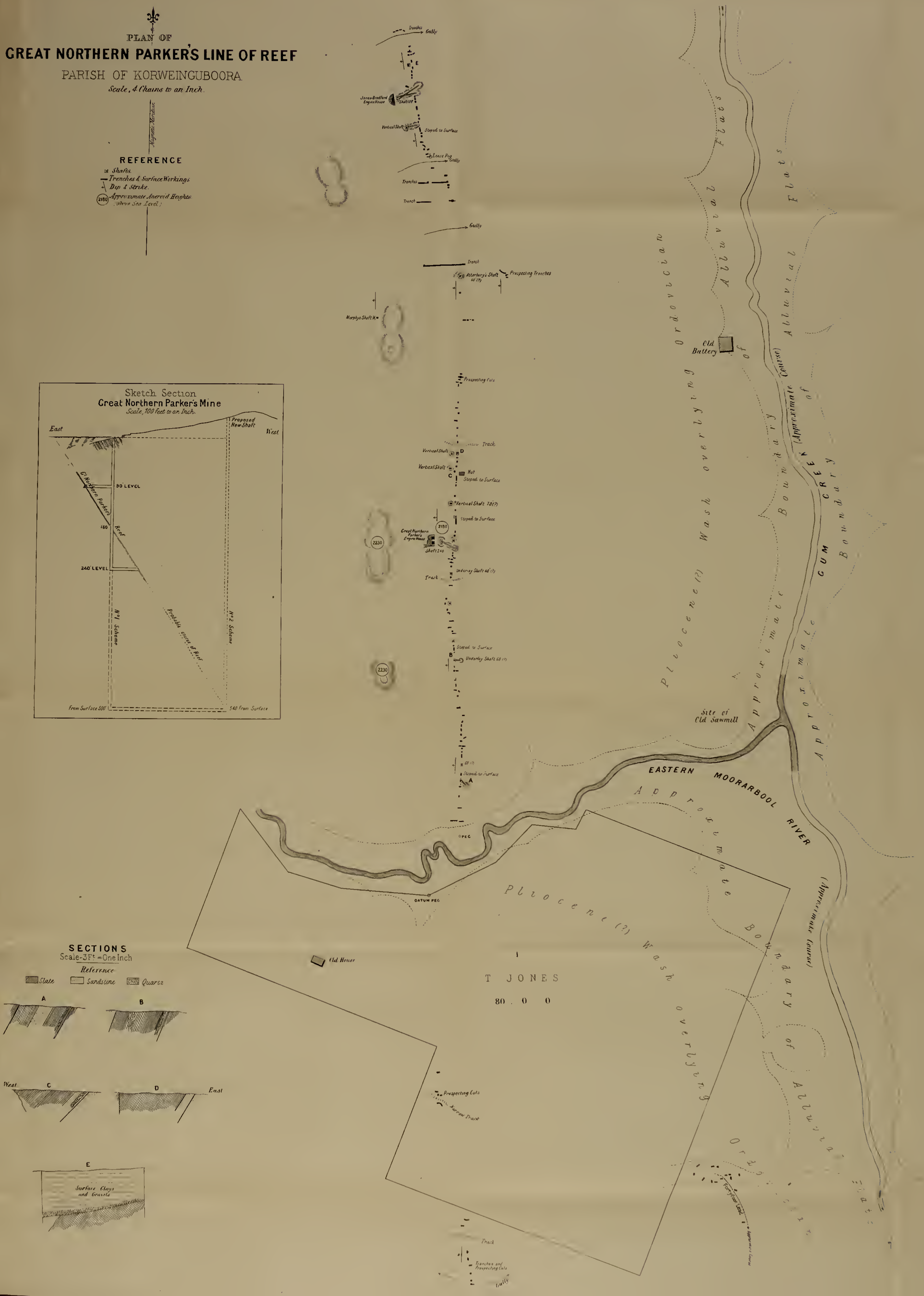
By Authority: Robt. S. Brain, Government Printer, Melbourne.

PLAN OF

GREAT NORTHERN PARKER'S LINE OF REEF

PARISH OF KORWEINGUBOORA

Scale, 4 Chains to an Inch.



GR